ALBERTA'S CLEAN WATER ACT

Alberta
ENVIRONMENT COUNCIL OF ALBERTA

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CONCLUSIONS AND RECOMMENDATIONS OF THE REVIEW OF THE CLEAN WATER ACT

Report of the Environment Council
of Alberta to the Minister of the
Environment

REVIEW OF THE CLEAN WATER ACT

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Preface

In response to a request from the Minister of the Environment, the Environment Council has undertaken a review of the Clean Water Act. This review falls under Section 7(1)(b) of the Environment Council Act, which states that the Council

> *...shall, on being requested to do so by the Minister, investigate any matter pertaining to environment conservation specified in the request and make its report on the matter to the Minister....*

This publication is the result of the Council's investigation.

The report comprises two sections. The first section, *Conclusions and Recommendations of the Review of the Clean Water Act*, is based on the findings of the second section, *Review of the Clean Water Act*. The report to the Minister lists 12 recommendations for improving the implementation and administration of the Clean Water Act and its supporting policies and programs. The second section presents the background information on which the recommendations are based.

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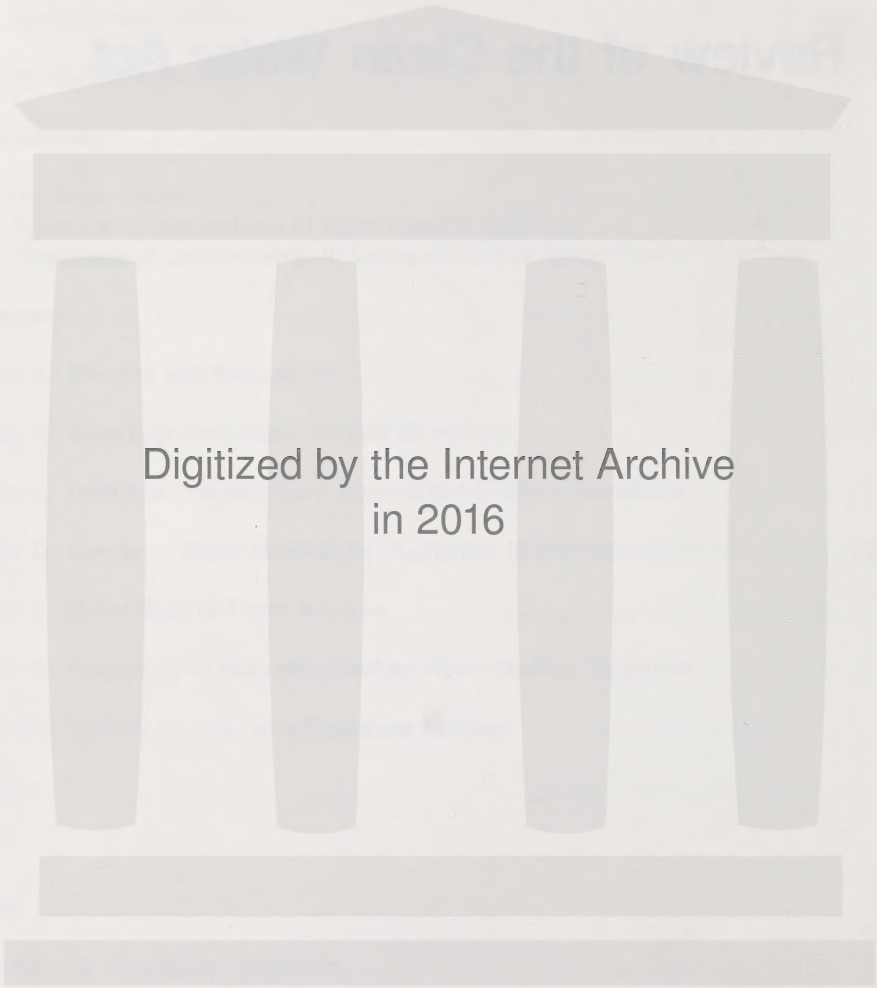

This report presents the main findings and recommendations of the Environment Council of Alberta's review of the Clean Water Act (RSA 1980, chapter C-13), its associated regulations and policies, and its role in the management of water quality in Alberta. It is based on a report written by ECA staff. The second section of this publication comprises that report.

SURFACE WATER QUALITY

A review of water quality data over the past 10 years shows a statistically significant improvement in nitrite and nitrate levels in the North Saskatchewan River. Other changes, both improvements and deteriorations, may have occurred, but they were not statistically significant. Other reviews have noted improvements in some aspects of water quality in the North Saskatchewan River and in the Bow River.

It is heartening, in light of Alberta's rapid growth in population and industrial capacity, that water quality has not deteriorated and may have improved. However, the results also show that Alberta's Surface Water Quality Objectives for some parameters are frequently exceeded at a number of locations downstream of the major municipalities. Alberta, therefore, must continue with its efforts in pollution control.

Recommendation

Alberta Environment should undertake a comprehensive study of the status of the province's water quality.

Although several reports on surface water quality have been published, no comprehensive study is publicly available. A comprehensive study would provide Alberta Environment and the public with an overview of the state of Alberta's water quality. This study should describe the present situation; identify trends in water quality; determine major contaminant sources, separating background levels from anthropogenic contributions; and pinpoint areas of potential concern. Used in conjunction with provincial goals for surface water quality, this study could aid in priority planning for pollution control, assist in the development of long-range policies, and assist in determining future licence conditions.

DEVELOPMENT OF A STATEMENT OF WATER MANAGEMENT GOALS, POLICIES, AND OBJECTIVES

The Clean Water Act has played an essential role in protecting water quality in Alberta. However, the effectiveness of the Act would be substantially enhanced by the addition of two elements: stated goals for water quality management and a process by which these goals are expected to be achieved.

Alberta Environment has a general goal for water quality of controlling pollution to protect the environment and the quality of life. However, neither "environment" nor "quality of life" have been defined. In addition, the Province has numerical objectives for water quality. These objectives, however, do not contain a statement of policy for water quality management nor do they identify a mechanism for implementation of a policy, if such a policy were to exist. There is no explanation of how the objectives will be applied, or of their relationship to the Department's responsibility to licence releases of environmental contaminants.

It is normal practice in a large and complex business enterprise to devote a great deal of effort to the establishment of precise goals for the enterprise and the policies and implementation procedures that will lead to achievement of these goals.

In this connection, the Ontario Water Management Goals, Policies, Objectives, and Implementation Procedures (Ontario Environment 1984) provide a model that Alberta Environment should consider.

Recommendation

> *The province should develop a clear statement of goals for water quality, the numerical objectives which should achieve these goals, and a statement of policies and guidelines to provide direction for efforts towards them. Much of the material necessary to develop such statements already exists in the Surface Water Quality Objectives.*

An explicit statement of policy would make the public and all water users more aware of the Government's intentions, provide stable goals for municipal governments and industrial developers, and provide a clear standard against which success in implementation and enforcement could be judged. Such a clear statement of policy would also be valuable for Department of Environment staff in providing a continual reminder of what it is that the regulations and permits they administer are expected to achieve.

The public also have a role to play in providing guidance to water quality managers and to governments with respect to the value judgments inherent in environmental protection. Public input, when added to the technical and scientific base, enables decision makers to make more informed judgments about the province's water quality goals and objectives.

WATER QUALITY MANAGEMENT CONCEPTS

Recommendation

Any change from the concept of water quality objectives which protect the most sensitive use towards the concept of beneficial use should occur only after a thorough review of the implications and consequences.

Beneficial use is a concept wherein the numerical values for water quality objectives depend on the use of the water, instead of having a single set of objectives applicable to all water bodies and aimed at protecting the most sensitive use. There are indications that the approach to water quality management in Alberta is changing from the approach of protecting the most sensitive use towards the concept of beneficial use. This change is occurring in the absence of clear goals such as are available in Ontario, but it may be that in the unique circumstances of Alberta the beneficial use concept is a more appropriate approach to water quality management. However, this change of direction should be adopted only after the most thorough review, both internally and through public consultation, of the implications and consequences.

PRAIRIE PROVINCES WATER BOARD

The activities of the Prairie Provinces Water Board (PPWB) also influence Alberta's approach to water quality management. The PPWB has considered the use of basin-specific water quality objectives and apportionment of the assimilative capacity in their planning activities. These concepts also have been developed for planning purposes in the South Saskatchewan River Basin Planning Program. However, recently the PPWB has been studying other methods, such as a "two-level system" for the determination of water quality requirements for interprovincial rivers. Water quality management within Alberta will be affected by the approaches ultimately adopted by the Board.

Recommendation

In its assessment of surface water quality objectives, the Province, as a participant in the PPWB, should consider the implications of the water quality management approaches which the Board is introducing.

CO-ORDINATION OF WATER QUALITY MANAGEMENT PROGRAMS

Although the Clean Water Act is Alberta's most significant piece of legislation affecting water quality management, other Acts administered by Alberta Environment and Acts and programs implemented by other departments also affect water quality.

For example, the Department of Energy and Natural Resources, although it does not directly have a mandate for water quality management, has been designated responsible under the federal Fisheries Act for protection and management of the province's fish resources and for enforcement of the Fisheries Act. There is an obvious relationship between fish habitat and management of water quality by Alberta Environment.

Generally, Alberta Environment has developed an efficient and co-ordinated approach to dealing with interdepartmental aspects of water management, but the distribution of responsibilities between these two departments, as well as uncertainties about jurisdictional overlaps between the Fisheries Act and the Clean Water Act, have created some difficulties. The two departments need to work closely together to establish common objectives and integrate complementary programs.

Recommendation

Policies and programs should be co-ordinated to ensure that the environmental protection activities of Alberta Environment are supportive of, and supported by, the programs of Alberta Energy and Natural Resources, with respect to protection of fish populations and habitats and enforcement of the Fisheries Act.

ALLOWABLE VARIANCE

Throughout the Clean Water Act and its regulations, discretion is given to the Minister and the Director of Pollution Control for the establishment of licence conditions and enforcement of the provisions of the Act. While discretion to some degree is essential, and while it can provide an efficient and flexible mechanism responsive to local economic, social, environmental, and technical aspects, its extensive use has created a credibility gap between departmental actions and public perception about the enforcement of environmental standards. While it may be logical and, from a technological point of view, eminently practical to recognize that 100 percent compliance is not possible, neither the terms and conditions of a licence nor the wording of the Act and the regulations acknowledge this. The public, therefore, sees a contravention as a violation, which should bring prosecution if observed, the favored public analogy being traffic violations. Licence conditions which give compliance expectations in the form of a permissible level of emission and an acceptable amount of variance, above which strict enforcement action would be taken, would provide a more appropriate base for enforcement. If emissions exceed the permissible level but are still within the acceptable limits for variance, enforcement action need only take the persuasive form of meetings or directives. A contravention of the acceptable variance could be treated as a violation requiring

legal enforcement action, such as control orders or prosecution. This approach is little different from what occurs operationally at present. The difference is that enforcement action would occur within clear, explicit, and publicly identifiable boundaries. Administering the Act in this manner would contribute greatly to increasing public confidence in the Department of the Environment.

Recommendation

The concept of allowable variance in emissions should be incorporated into the licensing of effluent releases wherever technically feasible.

MAXIMUM CONCENTRATIONS IN EFFLUENT DISCHARGE

Enforcement capabilities under the Act would be improved if regulations were used to establish limits on maximum concentrations and amounts of contaminants in effluent discharges. Limits at least as strict could then be incorporated into operating licences. The establishment of limits through regulation would be particularly useful in the application of the "general prohibition" clause with respect to individuals or operations that do not require licences under the Act.

Because there are no regulations which prescribe limits for the concentration of contaminants in discharges or surface waters, releases of contaminants by non-licenced operations or individuals are only loosely controlled by the existing legislation and enforcement practices.

Recommendation

Regulations establishing limits for acceptable concentrations and amounts of contaminants in effluent discharges should be developed.

UNCONTROLLED SOURCES OF DISCHARGES

Uncontrolled sources of periodic effluent releases such as agricultural livestock operations, irrigation drainage systems, and storm water drains cumulatively have the potential to substantially alter surface water quality. While the regulations recommended above would assist in controlling these sources of contaminants, the resumption of strong growth in Alberta could lead to increasing problems with uncontrolled contaminant sources. A pro-active approach by the Department would avoid or mitigate potential problems.

Recommendation

Approaches to managing periodic but presently unlicensed discharges of contaminated water should be developed by the Department.

MONITORING

Recommendation

Industries and the major municipalities should be required to expand their monitoring of releases of "exotic" contaminants.

Industrial effluent guidelines usually specify levels for "traditional" contaminants. Requirements for other contaminants may be added to the licence at the discretion of the Director of Standards and Approvals and this has occasionally been done for some "exotic" substances. Monitoring in accordance with these specifications will provide a data base which could be useful in identifying any emerging problems and appropriate actions.

A similar situation exists for municipal effluents. The "recommended standards" for municipal effluents specify no objectives for heavy metals or other chemicals, except oils and phenolics. A municipality accepts industrial effluents according to its own criteria, and is responsible for meeting the provincial requirements respecting the release of sewage. Even for major cities which accept substantial volumes of industrial waste, licences usually specify limits only for BOD and non-filterable residues and not for parameters such as metals.

With increasingly complex industries and the addition of more chemicals to the environment, questions regarding the significance, safety, and control of these chemicals have arisen. Monitoring for presence and concentrations of "exotic" materials, coupled with information provided by the recommended comprehensive study on Alberta's surface water quality, would help Alberta meet the challenge of dealing with potential problems posed by "exotic" chemicals.

AVAILABILITY OF INFORMATION

The Water Quality Control Branch of the Pollution Control Division previously published summaries of industrial monitoring data that identified the rate of compliance for each licence holder, gave the annual volume of industrial effluent, gave information on a licencee's performance including comparative results of government sampling, and

briefly commented on a company's pollution control activities. Summaries of municipal effluent monitoring or compliance have not been published. Publication by the Department of information including summary and compliance reports for municipalities and industries would increase public awareness of the Department's efforts in pollution control and could increase public support for the Department's activities.

Recommendation

The Department should publish reports providing summaries of industrial and municipal effluent releases and rates of compliance at least annually.

PUBLIC SCRUTINY OF ENVIRONMENTAL POLLUTION

Many environmental problems are identified as a result of public complaints. It would assist in the achievement of the Department's goals for environmental protection to encourage public vigilance and knowledge with regard to spotting and reporting instances of environmental pollution.

Recommendation

The Department should encourage reporting of environmental problems by the public.

DEPARTMENTAL SCRUTINY OF ENVIRONMENTAL MONITORING DATA

Since Alberta Environment does not conduct extensive monitoring on its own, the Department is heavily dependent on the provision of accurate information by facility operators in order to remain aware of possible contraventions, unauthorized releases, and potential problems. The Department's scrutiny of company-submitted environmental monitoring reports has proven to be a very important means of identifying environmental problems and initiating compliance actions. Departmental monitoring and plant inspections also play a role. These programs should be reviewed and assessed to ensure that they are being used to their fullest potential in environmental protection.

Recommendation

The Department should assess its program for review of environmental monitoring data and plant inspections to develop the most effective use of these programs in obtaining compliance.

THE ENVIRONMENTAL MANDATE OF THE ACT

Environmental concerns should play a greater role in the prevention of pollution. In the application of many provisions of the Act, consideration of environmental impacts is at the discretion of the Director of Standards and Approvals, the Director of Pollution Control, or the Minister. While environmental impacts are considered in the issuance of control orders and stop orders, as well as in other actions taken by the Department for implementing the provisions of the Clean Water Act, the Clean Water Act says little about environmental impacts. Environmental impacts are not part of the stated grounds for issuance of certificates of variance, control orders, or stop orders. Environmental considerations are specifically identified only with respect to the "general prohibition" clause (s. 17) in which reference is made to "fish, wildlife, livestock or plants" as well as human health and life.

Recommendation

Environmental impacts should be an integral part of the implementation of the Clean Water Act and their consideration should be explicitly allowed for in the legislation and regulations.

CLARIFICATION OF THE CLEAN WATER ACT AND ITS REGULATIONS

There also are several specific areas in which the wording of the Clean Water Act and its regulations could be clarified. The general prohibition clause in the Clean Water Act differs in wording from the prohibition clause in the Clean Water (General) Regulations. The prohibition clause in the Act refers to a substance which is likely to degrade or alter the water so that it "is or is likely to be rendered harmful to human health or life, fish, wildlife, livestock or plants" (s. 17). The prohibition clause in the regulations refers to "any substance capable of changing the quality of the water or causing water contamination" (s. 11). No cross-reference is made in the regulations to this resulting in water being rendered "harmful to human health or life, fish, wildlife, livestock or plants" as specified in the Act. The prohibition clauses would be improved if their intents were to be clarified and ambiguity removed.

One condition for issuance of a certificate of variance requires that the variance not be likely to result in "water pollution" that could be detrimental to life or health or adversely affect property. By definition in the Act, water pollution does not occur unless regulations are violated. Since no regulations have been promulgated, the meaning of this condition is unclear. Amendment of the Act to refer to "water contamination," which is defined in the Act, rather than "water pollution," would provide a clearer statement of the conditions for a certificate of variance. A similar clarification applies to the use of the term "water pollution" in the conditions for issuance of a stop order.

Under the Clean Water Act, stop orders may be used against a source of water pollution which is considered by the Minister to be an immediate danger to human life or property or both. Under the Department of the Environment Act, a stop order may be issued for a broader range of activities, including those that are likely to cause destruction, damage, or pollution of a natural resource. This latter wording appears to be the operational definition used by the Department.

The conditions under which a stop order may be issued under the Clean Water Act should be more clearly specified to avoid confusion between the operational interpretation (based on the Department of the Environment Act) and the sense implied by the Clean Water Act.

CONCLUSION

The Clean Water Act and the regulations were found to provide a strong basis for the protection of water quality in Alberta. However, the ECA has developed several recommendations which would improve water quality management and enhance the role of the Act.

There is a need for a comprehensive review of the present state of Alberta's water quality and, with the assistance of the public, a need for development of clear goals and policy direction within which the Clean Water Act can be implemented.

It is recommended that regulations be used to establish maximum permissible releases of contaminants for all effluent discharges and that allowable variances be written into the licence conditions wherever feasible.

Other recommendations include development of approaches to managing unlicenced discharges, and routine publication of monitoring and compliance data for industry and municipalities. An effort should be made to encourage reporting by the public of environmental offenses. Several suggestions are made for clarifying the wording of the Act.

REFERENCES

Ontario Environment. 1984. *Water Management – Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment.* Ontario Ministry of the Environment. Toronto. 70 pages.

Review of the Clean Water Act

1. Introduction

This report was prepared by the Environment Council of Alberta in accordance with its mandate to investigate, at the request of the Minister, any matter pertaining to environment conservation (Environment Council Act, c. E-13 s. 7(1)(b)). The Minister requested a review of the Clean Water Act and its role in water quality management in Alberta.

In undertaking such a review, it becomes apparent that the role and contribution of the Clean Water Act can be determined only against a statement of water quality management policy and philosophy in the province. Hence, provincial policy and approaches to water quality management have been reviewed as well as the Clean Water Act and its supporting regulations and guidelines.

The focus of the report is on the activities of the Department of the Environment. The role of Alberta Environment within the context of the total function of government is "to promote a balance between resource management, environmental protection and the quality of life" (Alberta Environment 1977b). With respect to water quality, the Department fulfills this role through administration of the Clean Water Act. Through the Act, the Department is given the authority to licence the release of contaminants into surface waters, through the licensing of facilities.

Under the authority of the Act, the Department of the Environment has prepared guidelines for municipal and industrial waste water effluents. These guidelines recommend limits for the release of contaminants. These guidelines or other appropriate limits are made enforceable by incorporating them in a facility's licence to operate.

Adherence to a licence to operate can be achieved through a variety of mechanisms available to the Department. This range of options includes directives, water quality control orders, and stop orders. All of these aspects of water quality management as well as the Department's monitoring programs are discussed in the report.

The report concludes with a discussion which ties together the role of the Clean Water Act in managing water quality and the present condition of Alberta's surface waters. Several suggestions are made for improving water quality management and strengthening the role of the Clean Water Act.

2. The Importance of Water

Water has been described as one of Alberta's most important natural resources (Alberta Environment n.d.a). It has supported human settlements and directed their distribution. As population increased and settlements grew in size, water supply and sewage disposal became critical. Improvements in our infrastructure for controlling and using water were made, including the construction of municipal sewage systems. Many industries developed a dependence on water: for cooling, lubricating, and cleaning; for use in industrial processes, and to remove wastes. Today, water is withdrawn, used, and returned in part, but not without changes. Temperature may change and organic chemicals, metals, nutrients, micro-organisms and pesticides may be added before the water is returned.

Each water body is different and supports an ecosystem adapted to its specific characteristics. That ecosystem is a product of flow patterns and volumes, as well as physical factors such as temperature and sediment loads and chemical factors such as nutrient levels and concentrations of metals and salts. These factors, in turn, determine the plant (algae, macrophytes), invertebrate (aquatic insects, crustaceans, zooplankton), and fish populations that inhabit the water body.

Aquatic ecosystems may be "stereotyped," or characterized by "indicator" species, but each aquatic community is in a state of flux, continuously adapting to changing conditions, particularly in flowing waters. For example, trout, which prefer cold, clear, well-oxygenated water, may move upstream seeking cooler water as water temperatures warm. Floods may scour the river bottom, removing organisms that are the preferred food of trout, and additions of silt may clog the stream bed gravels, rendering them unsuitable for trout spawning. On the other hand, pike may benefit from floods that inundate shoreline vegetation, thereby providing more spawning habitat. A silted stream bed may favor the growth of aquatic plants and provide ideal habitat for pike.

As the aquatic habitat changes so do the aquatic communities. These communities respond and adapt to changes in their environment whether the changes are natural or anthropogenic (that is, resulting from human activity). For example, changes in nutrient concentrations may favor the growth of certain plant species, additions of copper may drive away sensitive fish species, and silt additions have different impacts on different invertebrate and plant species. Any change will cause a response. In flowing waters, effects may be reversible if the addition is terminated, but a long-term change in water quality will cause an alteration in the aquatic ecosystem. These changes in turn can affect potential users. If an alteration in an aquatic ecosystem is minor, it may go unnoticed among normal variations; however, if an

alteration is substantial or impinges upon society's use of that water body, intervention may be demanded. For example, contamination of a swimmable water body that eliminates the fish population could go unnoticed if there were no fishing, but unsightly algal growths may cause a public furor.

Throughout the world, water is used as a medium for waste disposal. The underlying justification for this practice is that water has the capacity to transport, dilute, and assimilate waste. The classical concept of assimilation (self-purification) was developed to explain the replacement of dissolved oxygen used during the decay of organic waste (sewage) deposited in a watercourse. The theory is as follows: as the organic matter degrades, it uses oxygen dissolved in the water. This oxygen is replaced by the absorption of oxygen from the air or from aquatic plants. (Downstream of a municipal waste discharge, for example, the dissolved oxygen levels are reduced, but subsequently recover to normal levels further downstream.) At some point, the wastes will have been altered by the natural processes of the stream to the point that they no longer affect the oxygen content. The stream is then said to have assimilated the waste.

Unfortunately, the concept has been carried over to many situations in which substances remain, at least in part, active in the aquatic environment and may alter the ecosystem. For example, nutrients recycle through an aquatic ecosystem and may have a noticeable impact upon algae and plant growth in certain circumstances. Similarly, the concept of assimilation is used but does not accurately describe the fate of numerous chemicals which, although they may be diluted by the receiving water and transported downstream, are not assimilated but accumulate in or cycle basically unaltered through the ecosystem. When dealing with such substances, managers must consider how much dilution is occurring, what the possible effects are, and how much change in water quality is acceptable. From an operational point of view, "assimilative capacity" is often taken to mean the difference between the present or natural water quality and the level of water quality (or concentration of a substance) that administrators are prepared to define as acceptable.

It rests with the government, government agencies, and the public to decide on the goals for water quality; how to balance the economic, social, political, and environmental costs and benefits of water quality protection; and the approaches to be used to realize the goals. These goals should be reflected in the legislative framework and in the policies and programs of government departments. The next chapters attempt to identify the government's goals for water quality and then to assess the role of the Clean Water Act in achieving these goals.

3. Jurisdictional Aspects of Water Quality Management

FEDERAL RESPONSIBILITIES

Management of water resources, both for quality and quantity, within provincial boundaries is the responsibility of the provincial government. The federal government, however, has jurisdiction under the British North America Act (now the Constitution Act) for planning and managing water resources where there is a significant national interest. Examples of national interest would include the management of boundary, international, and interprovincial waters and situations in which federal jurisdiction over matters such as fisheries or navigation poses major concerns (Environment Canada 1978).

It is under the Fisheries Act (RSC 1970 c. F-14)* that some of the effluent regulations and guidelines adopted by the province have been designated. On the other hand, according to Thompson (1980) the existence of the Canada Water Act (RSC 1970 c. 5 1st Supp.) has acted as a spur to increased provincial action in water management.

Fisheries Act

It is the provisions of the Fisheries Act which are used most often by the federal government to deal with specific instances of water pollution.

The Fisheries Act applies to all waters in Canada, including "all internal waters." The most important prohibitions are: "no person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat" (s. 31(1)) and "no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish" (s. 33(2)).** Contravention of the first prohibition may result in a fine not exceeding $5,000 (first offense) or $10,000 (for subsequent offenses). Contravention of the second prohibition may result in a fine of up to $5,000 for the first offense and $100,000 for each subsequent offense. A deleterious substance is "any substance that, if added to any water, would degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water" (s. 33(11)). Water which contains a substance, or which has been altered from a natural state such that if added to

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* with amendments to May 4, 1981.

** Fish are defined in the Act as including shellfish, crustaceans, and marine animals.

any other water, would render that water deleterious, also is defined as deleterious. The prohibition on deposition of a deleterious substance does not apply if the deposition is authorized by regulations made by the Governor in Council (Federal Cabinet).

The provisions of the Fisheries Act have been used to designate national effluent regulations and guidelines for a number of industrial groups (Appendix A). These regulations tend to govern industries which are of national concern and which occur throughout Canada; some industrial groups, for example, heavy oil sands or tar sands plants, which are significant only in Alberta, have not been regulated nationally.

Regulations and guidelines may be reviewed periodically by Environment Canada and modified to allow for technology changes. The pulp and paper industry and metal mining regulations are presently undergoing such a review.

In general, the regulations apply to those industrial plants which began production after the regulations came into force, while the guidelines assist provincial agencies in determining the levels of contaminants which should not be exceeded by industries that were in operation at the time the regulations came into force. The regulations, developed in co-operation with the provinces and industry, apply best practicable technology to the control of deleterious substances in the waste water effluent. In most cases, the regulations are administered and enforced by the provinces.*

Under the Fisheries Act, the federal Minister also may request plans, specifications, samples, and other information from any person who carries on an undertaking that is likely to result in the deposit of a deleterious substance in water frequented by fish or the alteration of fish habitat (s. 33.1(1)). If, after reviewing the material, the Minister is of the opinion that an offense is being or is likely to be committed, he may order such modifications or additions as are considered necessary, or restrict the operation, or, with approval of the Governor in Council, close the undertaking for as long as necessary. If the Minister proposes to order such modifications or restrictions, he must offer to consult with the appropriate provincial governments and departments or agencies of the Government of Canada, but may make an interim order without consultation where immediate action is necessary.

Canada Water Act

The Canada Water Act was proclaimed on September 30, 1970. The legislation was developed because with "the trends in the 1960s towards large-scale, multipurpose water resource development where effects cut across several jurisdictions, co-operative federal-provincial arrangements [became] essential" (Fisheries and Environment Canada 1976: 2).

Under authority of the Canada Water Act, the federal Minister of the Environment may enter into agreements with the provincial governments for the management of water resources

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* Industries within the province are required to meet federal regulations. The use of the guidelines by the provinces is optional; however, it is the policy of Alberta to make its provincial industrial effluent guidelines at least as stringent as those developed by the federal government. If no federal regulations have been passed for an industrial group, control of that industry's discharges is at the discretion of the provincial government.

that have a significant national interest. The intent of the Act is to provide for the management of Canada's water resources, including research and the planning and implementation of programs relating to water resources and "their conservation, development and utilization to ensure their optimum use for the benefit of all Canadians" (preamble, Canada Water Act).

The Canada Water Act provides for management of water resources on a watershed basis through the formulation of federal-provincial agreements. Part I enables the federal Environment Minister, either directly or in co-operation with any provincial government, institution, or person, to conduct research, collect data, and establish inventories on any aspect of water resources. Under this mandate Environment Canada, in co-operation with Alberta Environment, conducts routine water quality and flow monitoring in Alberta and maintains the computerized data base which holds the information.

Part II contains provisions for federal-provincial agreements where water quality has become a matter of urgent national concern. Joint federal-provincial agencies may be established to plan and implement approved water quality management programs.

> *In carrying out these programs, the agencies can use a variety of tools, such as the setting of standards backed by the prospect of a heavy fine; effluent discharge fees designed to attach a cost to the discharge of non-toxic wastes, thereby providing an incentive to a discharger to take steps to reduce or eliminate the wastes he discharges; or user fees for wastes treated by facilities owned and operated by the agency* (Fisheries and Environment Canada 1976: 15).

It is federal government policy to address most water problems through a joint co-operative approach (Environment Canada 1978). However, if agreements between the federal and provincial governments cannot be reached, the federal Environment Minister may, with the approval of the Governor in Council, act unilaterally and impose an agreement in order to obtain co-ordinated management of the resource. The Governor in Council, however, shall not approve this unilateral action unless satisfied that all reasonable efforts have been made to to reach an agreement between the federal government and the governments of those provinces involved.

No water quality management agreements have been established under the Canada Water Act, either by agreement or by unilateral federal action. The reason, according to Thompson, is that:

> *The threat of unilateral federal action in the Canada Water Act, 1970 merely acted as a spur to increased provincial action to ensure that river systems remained under provincial control no matter what boundaries they cross* (Thompson 1980: 22).

The Canada Water Act also contains the nutrient control provisions which allowed the federal government to establish national limits on phosphorus content of detergents in the early 1970s.

INTERPROVINCIAL ARRANGEMENTS

Alberta contains the headwaters of many rivers and streams which flow across provincial boundaries into Saskatchewan, across federal boundaries into the Northwest Territories, and

across international boundaries into the United States. This is an enviable position with regard to the quality of water available for the enjoyment of Albertans, but it carries with it great responsibilities for protection of this water quality for downstream recipients.

Management of water quality in the Milk River, which crosses into the United States, has not to date been of great concern because of the lack of industrial and municipal pollution sources in this watershed.

On the Slave River, passing into the Northwest Territories, the large dilution factor and sparseness of downstream users have minimized the need for management of water quality. Investigations of the feasibility of a hydro-electric power project on the Slave River, however, have greatly heightened interest in water management within that basin. A three-year study by the Mackenzie River Basin Committee to facilitate future co-operation in planning and management was completed in 1981 (Mackenzie River Basin Committee 1981). The Committee's first recommendation was that an agreement among the various jurisdictions be concluded at an early date; they anticipated an agreement through which transboundary water management issues such as minimum flows, flow regulation, and water quality could be addressed. Initial talks are now underway.

While development of interjurisdictional agreements for the Mackenzie River Basin is just beginning, agreements related to water flowing across the provincial boundary into Saskatchewan date back many years. The Prairie Provinces Water Board (PPWB) was created in 1948 to make recommendations to the governments involved on the allocation and best use of the interprovincial waters. There are five Board members, one each from Alberta, Saskatchewan, and Manitoba and two from Canada. Each of these five members has appointed representatives to the various PPWB committees.

In 1969, the four jurisdictions signed the Master Agreement on Apportionment and agreed to equitably apportion waters of interprovincial streams. The agreement is administered by the Prairie Provinces Water Board. The Board's function is to make recommendations to the participating governments on the best use and allocation of interprovincial waters. The Master Agreement on Apportionment does, however, contain an article stating:

> *If at any time, any dispute, difference or question arises between the parties with respect to this agreement or the construction, meaning and effect thereof, or anything therein, or the rights and liabilities of the parties thereunder or otherwise in respect thereto, then every such dispute, difference or question will be referred for determination to the Exchequer Court under the provision of the Exchequer Court Act of Canada...** (PPWB 1984: 47).

To date, no such dispute has arisen. This supports Thompson's contention that the provinces will take whatever action is necessary to ensure that river systems remain under provincial control (Thompson 1980).

Although the Master Agreement was specific in dealing with the quantitative apportionment of water, it was silent on the way in which effective interprovincial water quality management

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* The Exchequer Court is now the Federal Court of Canada.

could be achieved. To address this concern, the PPWB established a Water Quality Task Force. This Task Force led to the formation of a Water Quality Committee and adoption by the PPWB in 1973 of water quality objectives developed jointly under the direction of the Board (PPWB 1980). These objectives, numerically, are identical to the Surface Water Quality Criteria adopted by the Alberta Department of Health in 1970 except for a more stringent objective for nitrogen (total inorganic and organic) of 0.5 mg/L compared with 1.0 mg/L. The values stated were intended to be maximum acceptable levels that should not be exceeded at any time for effective downstream management. It is not, however, the approach of the PPWB to place specific restrictions on Alberta's intraprovincial use of water. Good water quality management would aim to stay as far below these levels as practically possible.

The PPWB water quality objectives and their use were, however, demonstrated to be inadequate by the Board's Committee on Water Quality. In several cases in Alberta the concentration of substances in the "natural" water exceeded the 1973 objectives. Because of this, in 1979, the PPWB published Interim PPWB Water Quality Requirements for the Beaver River (a tributary of the Churchill River system) which flows from the Cold Lake area of Alberta into Saskatchewan (PPWB 1979). The interim requirements provided new guidelines for industries planning development in the area and for municipalities which may face the need to upgrade their sewage treatment facilities. The document also introduced an interim water quality management procedure based on definition and apportionment of the assimilative capacity of the Beaver River. In the interim requirements, "assimilative capacity" is defined as the difference between the natural water quality and the PPWB-determined maximum acceptable level for contaminants in the watercourse. Water quality objectives at the border are set at the midpoint between the defined natural level and the maximum acceptable level. The introduction of this concept represents a change in approach from that taken by the 1973 objectives, which were to be uniform across the Prairies. The new requirements for the Beaver River attempt to apportion the "assimilative capacity" of a specific river system. Where natural levels exceeded the previous objectives, assimilative capacity is now available because the acceptable levels for some contaminants have been increased.

The document describing the new maximum acceptable concentrations provides no rational for the concentrations now deemed acceptable. Documentation for these selections will be contained in a separate report that will support the water quality requirements finally chosen for the Beaver River. These yet-to-be-published requirements will replace the interim values now used for the stream (Godwin 1985: pers. comm.).

In the Interim Water Quality Requirements, some 1973 PPWB objectives were made less stringent because natural concentrations occasionally were higher than the 1973 objectives. For example, for total phosphorus, the defined natural concentration is 0.15 mg/L, the maximum acceptable concentration, 0.30 mg/L, and the PPWB requirements at the border, 0.22 mg/L. The previous PPWB objective (1973) and Alberta objective (1977) for total phosphorus was 0.15 mg/L. For total chromium, the respective levels are: natural levels, less than 0.02 mg/L; maximum acceptable, 0.10 mg/L, and PPWB requirement, 0.05 mg/L for water entering Saskatchewan. The previous objective was 0.05 mg/L. Some of the new requirements were made more stringent. For example, the numerical value for copper was reduced from the 1973 objective of 0.02 mg/L to 0.003 mg/L in the interim requirements document.

With these revised objectives, industrial development and municipal growth in the Beaver River basin, which might otherwise not have been feasible, may be accommodated. Development, however, will still have to meet strict effluent water quality conditions if the new PPWB requirements are not to be exceeded.

Alberta's industry and municipalities will be allowed to use the river to dispose of some waste as long as uses in the downstream provinces are not adversely affected. The PPWB believes the water quality requirements will protect the downstream users against degradation of their water supply. The apportionment of the newly defined assimilative capacity of the Beaver River also allows Saskatchewan to use the river to dispose of waste.

The interim requirements are now applicable to the Beaver River, and the proposed approach is being used to develop site-specific water quality requirements for the South Saskatchewan and Red Deer River monitoring sites. However, the PPWB's Committee on Water Quality is already refining the use of site-specific requirements. The Committee is trying to find ways whereby more emphasis can be placed on maintaining the stream as close to existing conditions as possible. One favored alternative is a two-level approach in which action would be taken when water quality exceeds either the maximum acceptable concentration or a lower "warning bell" level which would indicate a change in quality as calculated on a seasonal or annual basis. After an acceptable approach has been developed and implemented for the Beaver River basin, the PPWB intends to apply this approach to other interprovincial river systems. For example, as part of the planning process for the South Saskatchewan River Basin, a consultant was engaged by Alberta Environment to develop water quality targets using concepts similar to those used for the Beaver River (see ESL 1983). These water quality targets were intended for use in framing and assessing water use and management options in the basin.

In summary, interprovincial water quality management is in a process of evolution. Water quality objectives adopted by the PPWB in 1973 remain the operable objectives for all Prairie rivers with the exception of the Beaver River. For that basin, new Interim Water Quality Requirements have been adopted. These requirements introduce two concepts: basin-specific water quality requirements and apportionment of assimilative capacity between the provinces (Alberta and Saskatchewan). These concepts have also been developed for planning purposes in the SSRB. However, the PPWB is studying other methods for determining interprovincial water quality. Water management in Alberta will be affected by the approach chosen by the PPWB and development of new policies for Alberta must take this into account.

PROVINCIAL RESPONSIBILITIES

In Alberta, the main responsibility for management of the province's water resources rests with the Minister of the Environment. The Department of the Environment Act (RSA 1980 c. D-19) established the Department and, among other things, gave the Minister authority to "generally, do any acts he considers necessary to promote the improvement of the environment for the benefit of the people of Alberta and future generations" (s. 7h). The Minister also has responsibility for co-ordinating the policies, programs, services, and administrative procedures of government departments and agencies in matters pertaining to the environment, including the prevention and control of pollution of natural resources (s. 7a).

The responsibilities of the Minister with respect to the prevention and control of pollution of the province's water resources are spelled out in the Clean Water Act (RSA 1980 c. C-13*). This Act is the keystone to the legislative framework for management of water quality and will be discussed in the next chapter. The management of water resources, including quality aspects, occurs within the overall framework of provincial policy as outlined in the Role and Mission of Alberta Environment (Alberta Environment 1977b) and in the Water Resource Management Principles for Alberta (Alberta Environment n.d.a).

The role of Alberta Environment "within the context of total function of government, is to promote a balance between resource management, environmental protection and the quality of life" (Alberta Environment 1977b: 2). One of the major program and responsibility areas of the Department is pollution prevention and control. In keeping with the above role statement, the purpose of pollution control programs is "to prevent or control pollution in order to protect the environment and the quality of life" (Alberta Environment 1977b: 5).

Promoting a balance between resource development, environmental protection, and the quality of life involves trade-offs between the costs and the benefits of environmental control. As Briggs points out,

> *This does not mean that there will not be environmental effects when resources are developed, but rather that the benefits (economic and social) must be weighed against the costs (environmental and social). On a provincial, regional, or local level, the leaders who control the resources and the environmental programs must decide where this balance lies* (Briggs 1983: 8).

Attaining this balance is a matter of judgment by water resource managers and ultimately by the political process.

The publication *Water Resource Management Principles for Alberta* provides an indication of the Department's policies with respect to water quality. The principles recognize that "a plentiful supply of good quality water, widely distributed, is a fundamental requirement for balanced economic growth and an expanding population in Alberta" (Alberta Environment n.d.a: 4) and that "the water resources of Alberta are to be managed in support of the overall economic and social objectives of the Province" (Alberta Environment n.d.a: 9). These objectives are best achieved by a strategy which obtains "from the water resources a maximum benefit for Albertans, while ensuring that the water is in a condition for beneficial use for an indefinite period" (Alberta Environment n.d.a: 9). Water quality aspects are specifically dealt with in Principle No. 11, which states in part:

> *The Government is committed to a program to prevent or control water pollution. Water quality objectives, at least as stringent as those set nationally in Canada, have been defined and apply to all surface water bodies....The principle that pollution must be controlled at its source is a key component of the Government's program. The Government's strategy is to be preventative. The assimilative capacity of receiver streams is, however, recognized. The assimilative or self-purification capacity of water-courses must be regarded as a natural resource that is legitimate to use. Use of a stream as a receiving body for water discharge must never cause any break in the ecological cycles that ensure the self-purification process* (Alberta Environment n.d.a: 12).

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* As amended to June 1, 1982.

Principle No. 3 states that water quantity and quality must be taken as two aspects of the same problem.

The Clean Water Act is the primary operational tool whereby those principles related to water quality can be implemented and water quality in Alberta protected. This report, therefore, focuses on that Act and its role. However, control of pollution and protection of water quality through use of the Clean Water Act is only part of the picture. In keeping with Principle No. 3 of the Water Resource Management Principles, consideration is given during the licensing of consumptive water uses to the impact which instream flows have on water quality and use. The impact of flow management on water quality is also considered in the development of water management plans such as the South Saskatchewan River Basin Planning Program. In this program, for example, water quality criteria were developed for different water uses, that is, fisheries, public water supply, recreation, irrigation, livestock consumption, and industrial use (Alberta Environment 1983a). Future water quality conditions for projected stream flows were then simulated through computer modelling to determine probable effects of implementing different development scenarios.

Certain aspects of the control of water pollution also are contained in several Acts which are not administered by Alberta Environment. For example, the Public Health Act (RSA 1980 c. P-27) administered by the Department of Social Services and Community Health establishes a Provincial Board of Health and Local Boards of Health. According to Section 6 of the Public Health Act, the Provincial Board of Health* may make regulations concerning the construction, maintenance, operation, cleansing, and disinfecting of all drains, sewers and sewerage systems, and systems of sewage disposal. No such regulations have been made; instead, regulation of municipal sewerage systems is done through the Clean Water Act and the Clean Water (Municipal Plants) Regulations (AR 37/73**) (see Chapter 4). The Provincial Board of Health, however, has an interest in the operation of municipal plants from a health point of view. For example, it was public health officials who took the City of Drumheller to court after a sewage overflow apparently resulted in contamination of the city's water supply.

Sewerage systems which supply individual needs and which do not discharge directly to surface waters (that is, sewage fields, leaching cesspools, and No-Dac filters) are exempted from those portions of the Clean Water Act that require the operators to obtain a permit or licence under that Act. Such sewerage systems are also exempted from provisions of the Clean Water (General) Regulations (AR 35/73***) by Section 2 of those regulations. The regulation, licensing, and inspection of private dwelling sewage disposal systems is done by plumbing inspectors under the Plumbing and Drainage Act (RSA 1980 c. P-10) administered by the Department of Labour.

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* A representative of Alberta Environment is appointed a member of the Board.

** With amendments up to and including AR 83/82.

*** With amendments up to and including AR 408/84.

According to the Plumbing and Drainage Act, a person intending to install a plumbing system (including a private sewage disposal system) must apply to the chief inspector or a municipal inspector for a permit. The Plumbing and Drainage Regulations (AR 340/77*) specify aspects such as location of sewage disposal systems, protection of water supplies, operation of the system, and requirements with respect to septic tanks, leaching cesspools, and subsurface effluent disposal. Once systems are installed properly, subsequent operating problems which may have health implications are the responsibility of the Public Health inspectors.

The exemption clause in the regulations has, however, created some problems. Some acreage developments encountered difficulties with individual sewage systems and turned to systems which handle the needs of an entire development. The Department of Labour's plumbing inspections covered only private dwellings and, hence, the acreage developments' combined sewage systems were not inspected. According to the Clean Water Act and its regulations, these systems also fell outside that Act. A recent Roles Agreement between Alberta Environment and the Department of Labour placed the responsibility for sewage lagoons or other types of surface disposal systems located within the property line of the development with the Department of Labour, but if surface effluent is discharged beyond the property line, the plans are referred to Alberta Environment for comment. Any subsurface disposal system located within the property line of a development requires approval only from the Department of Labour (Alberta Environment and Alberta Labour 1984).

The Department of Utilities and Telecommunications is involved in water quality management through its administration of the Municipal Water Supply and Sewage Treatment Grant Program, a responsibility transferred from Alberta Environment in the fall of 1982.

For municipalities of 600 or less in population, capital costs are shared on a 75:25 provincial-municipal basis. Costs are shared on a 50:50 basis for municipalities with a population between 601 and 100,000. There is an upper limit on the combined costs of water supply and sewage treatment projects of $2,100 per capita for municipalities of 600 or more population. For communities of less than 600 population, per capita grants may be larger. This program is co-ordinated through a close working relationship with Alberta Environment, which identifies and priorizes projects which the Department believes should be funded for environmental protection reasons.

The Department of Energy and Natural Resources (although it does not directly have a mandate respecting water quality management) has been designated responsibility under the federal Fisheries Act for protection and management of the province's fisheries resources and for enforcement of certain aspects of the Fisheries Act. This mandate is carried out by staff of the Fish and Wildlife Division. The management of water quality by Alberta Environment under the Clean Water Act, therefore, has a direct impact on the effectiveness of the Fish and Wildlife Division in carrying out its mandate. This distribution of responsibilities between two departments, as well as continuing uncertainties about jurisdictional overlaps between the Fisheries Act and the Clean Water Act, has created some difficulties. It has been

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* With amendments up to and including AR 107/82.

suggested, for example, that oil sands plants, for which there are no special licensing provisions under the Fisheries Act, could be in breach of the Fisheries Act even if licensed under the Clean Water Act (Hunt 1985: pers. comm.). This situation makes planning by industry and government difficult and requires clarification.

At the provincial level, the present situation demands a great deal of co-ordination of effort between Alberta Energy and Natural Resources and Alberta Environment. Policies and programs should be co-ordinated to ensure that environment protection activities of Alberta Environment (that is, licensing and enforcing limits on the release of water contaminants and effluent and ambient monitoring) are supportive of and supported by the programs of Alberta Energy and Natural Resources with respect to protection of fish populations and habitats. Both Olding (1981) and Maruschak (1983) identified the need for integration of the activities of the two departments. The two departments need to work more closely together to establish and integrate common program objectives in order to make efficient use of the departments' resources. Programs such as the South Saskatchewan River Basin Planning Program and Cold Lake-Beaver River Water Management Study may provide opportunities for this closer co-operation.

The Energy Resources Conservation Board also has a significant role to play in water quality management. Established by the Energy Resources Conservation Act (RSA 1980 c. E-11*), the Board has among its responsibilities "to control pollution and ensure environment conservation in the exploration for, processing, development and transportation of energy resources and energy" (s. 2d). The duties of the Board interrelate with those of Alberta Environment with respect to control of water pollution where the potential pollution source originates from the energy industry.

The Oil and Gas Conservation Act (RSA 1980 c. O-5**) and regulations administered by the ERCB reflect this interrelationship. For example, Section 10 of the Act permits the Board to make regulations which must, however, be approved by the Minister of the Environment. Regulations have been made covering aspects such as drilling and production operations in water-covered areas; the location, methods of operation, and measures to be taken to control pollution in the drilling or operation of wells (AR 151/71***). As well, any water produced from a well must be disposed of in a manner satisfactory to the Board (s. 8.040, Oil and Gas Conservation Regulations).

Similarly, the ERCB is required by the Oil and Gas Conservation Act to refer to the Minister of the Environment for approval of any applications for the processing or underground storage of gas or the disposal of any substance to an underground formation through a well (s. 26(2)),† or any schemes for the recovery of oil sands, crude bitumen, and derived pro-

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* As amended to December 1, 1982.

** As amended to June 15, 1982.

*** With amendments up to and including AR 337/82.

† In practice, salt water injected for pressure maintenance or for disposal at depths greater than 600 meters is handled by the Board alone. Injection at less than 600 meters and injection of some other materials or wastes are referred to Alberta Environment.

ducts (s. 31). The Minister may attach any conditions to the approval and the Board is required to impose these conditions unless otherwise directed by the Lieutenant Governor in Council.

The Oil and Gas Conservation Regulations require also that applications for gas processing plants and petrochemical plants be filed with the ERCB. The applications must be approved by the Director of Standards and Approvals (Alberta Environment) and the Minister of the Environment as well as the Board with respect to the location, conservation levels, and pollution control features (AR 151/71) before the project may proceed. The disposal of process water, sanitary water, or surface run-off water from these plants requires permits and licences pursuant to the Clean Water Act and, if disposal is to an underground formation, approval from the ERCB as well. Section 8.050 of the Oil and Gas Conservation Regulations requires that operators of wells or batteries take action to clean up spills of oil and salt water and to immediately report these spills to the Board. If oil or salt water is spilled while in transit, the spill is reported to both the ERCB and Alberta Environment.

It is evident that close co-operation is required between the ERCB and Alberta Environment in order for the Minister of the Environment to carry out his responsibilities for co-ordination of policies, programs, and services related to the prevention and control of pollution of natural resources. This need for co-operation was recognized in the development of ERCB Informational Letter IL 80-19, jointly signed by the Deputy Minister, Alberta Environment and the ERCB Chairman. This letter outlined the responsibilities of each party regarding the preparation of Environmental Impact Assessments for use in the ERCB's hearing procedures for projects including sour gas processing plants, coal mines, power plants, oil sands development, industrial facilities, pipelines, and transmission lines. This information letter has been superseded by specific guidelines developed and issued jointly by Alberta Environment and ERCB. These guidelines specify the required environmental content of applications which are part of the ERCB approval process.

This brief discussion of the roles of some of the departments and the Acts they administer, and how these affect water quality management, highlights the complex nature of the issue. It serves to point out the importance of co-operation between these departments and of integration of the programs administered by each department. Many activities directly and indirectly affect the resultant quality of Alberta's surface waters; some of these activities are directly controlled by legislation, but many are not.

4. The Clean Water Act

The Clean Water Act is the base on which has been built the provincial system for permitting, licensing, monitoring, and enforcing the release of contaminants into surface waters. The Clean Water Act permits regulations to be promulgated, establishes the framework for licensing plants which produce waste water effluents, and, through a general provision, prohibits the deposition of a contaminant in water if that contaminant is likely to make the water harmful to human health or life, fish and wildlife, or livestock or plants.

The organization of Alberta Environment reflects its responsibilities under the Clean Water Act: responsibility for standard setting and licensing rests with the Standards and Approvals Division and responsibility for monitoring and control of emissions rests with the Pollution Control Division. Both of these divisions, along with two others (Earth Sciences Division and Research Management Division), are within Environmental Protection Services. This Service, one of four within the Department, is under the direction of an Assistant Deputy Minister. The mandate of Environmental Protection Services is "to prevent or control pollution," and "to encourage research into applied solutions for environmental problems" (Alberta Environment 1983b: 24).

The Standards and Approvals Division processes applications submitted by either municipalities or industries for permits and licences under the Clean Water Act and the Clean Air Act. Additional responsibilities are "the review of relevant legislation for potential amendments, and the development of various emissions and effluent guidelines for municipal and industrial operations" (Alberta Environment 1983b: 30).

The Pollution Control Division enforces legislation and regulations, including the Clean Water Act and its regulations, in order "to achieve safe and publicly acceptable levels of environmental quality" (Alberta Environment 1983b: 25). With respect to the Clean Water Act, the Division's functions are to enforce the Act, its regulations, and its licence conditions and to maintain an acceptable level of surface water quality throughout the province. This is achieved through inspections, monitoring, investigating complaints, and training of municipal utilities operators.

The Clean Water Act requires that a permit be obtained before commencement of construction of any industrial plant, water works system, waste water treatment facility, or sewer project that may be a source of water contaminants. The Clean Water Act and the Regulations specify the information requirements and application process for the permit.

Before a person may commence operation of a water facility,* a licence to operate is required as specified in the Act and the Regulations. (Whenever water is diverted from a watercourse, a licence is also required under the Water Resources Act (RSA 1980 c. W-5), which deals with matters related to water quantity rather than quality.) The licence usually specifies that the facility shall operate as described in its licence application or in accordance with the appropriate effluent guidelines issued by the Standards and Approvals Division.

Under the Clean Water Act, it is an offense to construct a water facility without a permit or in contravention of a permit (s. 3(12)), or to operate a water facility without a licence or in contravention of a licence's terms and conditions (s. 4(8)). (Permits and licences and their terms and conditions are discussed more fully in Chapter 8). The Director of Standards and Approvals may serve notice to cease construction if a person commences construction of a water facility without a permit, or if construction does not comply with the submitted specifications and the terms of the permit (s. 3). The threat of a notice being served, therefore, ensures that construction is occurring or has occurred as detailed in the permit. Non-compliance with a notice is an offense liable to a fine not exceeding $5,000 for each day during which construction work was done in contravention of the notice.

Licences may be amended by the Director of Standards and Approvals on the Director's initiative or upon application of the person who holds the licence (s. 7(4)). If substantial alterations are to be made to a facility, the person must apply for a new licence or an amendment. Application also must be made for renewal of an operating licence before the expiration of its term, normally five years.

The Clean Water Act authorizes the Minister of the Environment to make regulations "prescribing water contaminants and the maximum permissible concentration in surface water of any water contaminant either generally or with respect to any part of Alberta or any water course specified in the regulations" (s. 2(1)(a)). Regulations may prescribe methods for determining concentrations, prescribe the maximum temperature, and prescribe maximum permissible calculated concentrations. As well as regulations that apply to the quality of the receiving water body (ambient water quality), the Minister may make regulations applying to effluent discharges: maximum concentration, amounts, rates of discharge, and methods for determination (s. 2(1)(e),(f),(g),(h)). The regulations are discussed in Chapter 6.

In addition, the Lieutenant Governor in Council may make regulations governing the application for, issuance of, and the terms and conditions attached to permits and licences. The Lieutenant Governor in Council may also make regulations governing the design, construction, and operation of any type of water facility. The Lieutenant Governor in Council may also exempt a source of contaminants from provisions of the Act and establish and classify the use of water and the use of all or any watercourses in Alberta.

The Clean Water Act defines a "water contaminant" as "any solid, liquid, or gas, or a combination of any of them, in water" or "heat in water, resulting in a change in the temperature of surface water or underground fresh water" (s. 1(m)). A water contaminant

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* "Water facility" is explicitly defined in the Clean Water Act. The term means any plant, structure, or thing that may be a source of water pollution.

becomes water pollution only if it is "in excess of the permissible concentration prescribed by the regulations for that water contaminant" or if there is "a change of the temperature of water in contravention of the regulations" (s. 1(p)). As will be discussed in Chapter 6, regulations have not been made to prescribe limits on the release of contaminants. Instead, a plant's operating licence states the maximum concentration and the total daily releases of certain water contaminants which the plant is authorized to release. Water quality control orders may be issued if it appears that a term of a licence has been or is about to be contravened.

Section 17(1) of the Act prohibits the deposit of a water contaminant in a watercourse, surface waters, or in underground fresh water where that water contaminant

> *...is likely to degrade, alter or form part of the process of degradation or alteration of the chemical or biological quality of water, so that the water in the watercourse, surface water or underground fresh water is or is likely to be rendered harmful to human health or life, fish, wildlife, livestock or plants.*

This section of the Act was amended in 1980. Prior to the amendment, the provision closely paralleled a similar provision in the Canadian Fisheries Act that prohibits the deposition of "deleterious" substances. Proving that a substance is deleterious has proven difficult in a number of court cases and the amendment was made to improve the usefulness of this section of the Clean Water Act.

After a facility has been built and the Director of Standards and Approvals has issued a licence to operate, responsibility moves to the Director of Pollution Control. It is that Director's responsibility to ensure that a water facility is operating in accordance with its licence and the regulations under the Act. The enforcement of the Clean Water Act is discussed in detail in Chapter 10; however, control orders, stop orders, and certificates of variance will be described here briefly.

A water quality control order (s. 14) may be issued by the Director of Pollution Control if it appears that the concentration of a water contaminant in surface water or underground fresh water exceeds or will exceed the maximum concentrations prescribed by regulations or if the surface or groundwater contains a water contaminant that has a disagreeable appearance, or is likely to be detrimental to life or health, or to adversely affect property, or was deposited without authorization. These conditions for issuance of a control order are related to the quality of surface or groundwater (ambient water quality)* and, used in conjunction with the provision in the Act for the promulgation of regulations for surface water quality, were intended to provide the means by which potable water quality would be protected (Milos 1985: pers. comm.).

For effluent discharges, a control order may be issued if a water contaminant has been discharged, or is being discharged, from a water facility in concentrations or amounts which

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* The provisions in the Clean Water Act protecting groundwater quality are the only such provisions in Alberta's environmental legislation. Except for these provisions, the quality of Alberta's groundwater is protected only by the general powers of the Minister under the Department of the Environment Act.

exceed the maximum permitted by regulation, or if a term or condition of a licence has been or is about to be contravened.

In a water quality control order, the Director of Pollution Control may direct the person owning or operating a water facility, including municipal corporations, to limit or halt the discharge of the water contaminant, to install equipment to control the discharge, to measure the rate and amount of discharge, and to report to the Director with respect to any actions ordered. It is an offense not to comply with a control order; however, control orders may be amended or revoked by a further order from the Director (s. 14(7)).

A stop order may be issued by the Minister if he or she is satisfied that a person has or is contravening the Act, a regulation, or an order under the Act; has failed to comply with an order from the Director of Pollution Control; has contravened a term or condition of a licence; or is operating a plant that is a source of water pollution that the Minister considers to be an immediate danger to human life or property (s. 15(1)).

The stop order may require the person to cease the contravention and stop any operation either permanently or for a specified period. Failure to comply is an offense and liable to a fine of not more than $50,000 for each day the offense continues or a term of imprisonment of not more than 12 months, or both. The Minister may get a court order directing the person to comply with the stop order and an officer of the Department may enter the property to carry out the stop order.

Stop orders may be appealed to the Minister within 15 days after the service of the order. The Minister refers the appeal to the Environment Council of Alberta, which is required to hold an inquiry within 30 days and report to the Minister giving its recommendations with regard to confirmation, amendment, or revocation. The Minister may then confirm, amend, or revoke the stop order and notify the person.

The holder of a permit or licence may apply to the Minister of the Environment for a "Certificate of Variance" to vary a permit or licence (s. 11). The Minister may issue a certificate if three conditions apply. First, the contravention must be the result of factors beyond the control of the applicant. Second, "the variation [must be] not likely to result in water pollution of a degree that could be detrimental to life or health or adversely affect property" (s. 12(1)(b)). Third, if refusal to grant a certificate would result in severe hardship to the applicant without offsetting benefit to others, the Minister may issue a certificate.

If a certificate of variance is issued, the Minister may impose terms and conditions and specify requirements as to the manner in which the water facility is operated. A certificate of variance is valid for the period prescribed and applies only to those terms and conditions which are specified. It is an offense not to comply with a certificate of variance.

5. Providing Direction for Water Quality Management

ALBERTA SURFACE WATER QUALITY OBJECTIVES

The publication *Alberta Surface Water Quality Objectives* (Alberta Environment 1977a) provides a set of criteria by which the Department can measure whether its purpose has been achieved. This document provides the province's numerical objectives for water quality; it does not provide a statement of what goals will be accomplished if these objectives are achieved.*

The Clean Water Act gives the Minister of the Environment authority to make regulations prescribing "water contaminants and the maximum permissible concentrations in surface water of any water contaminant" (s. 2(1)(a)). These regulations could apply generally or specifically to any part of Alberta or any watercourse; however, no regulations prescribing ambient standards have been made. In their place, the Director of Standards and Approvals has published Surface Water Quality Objectives.

Franson et al. (1982) provide a comparison of Alberta's surface water quality objectives and those of other jurisdictions. The conclusions will not be repeated here, except to say that there is no consistent relationship between the objectives chosen for specific contaminants by Alberta and those chosen by Environment Canada (Environment Canada 1972), other provinces, or the United States Environmental Protection Agency (EPA 1976). Alberta's objectives are sometimes more stringent, sometimes less stringent, and sometimes non-existent.

Alberta's objectives cover only a limited number of parameters. Alberta does not have objectives for beryllium, magnesium, nickel, chloride, chlorine, total dissolved solids, chlorine residuals, or sulphate, although some other provinces do. As well, Alberta has a general objective for pesticide levels rather than specific objectives for each pesticide, which is the approach taken by British Columbia, Ontario, and the federal government. Alberta's objectives are sometimes less stringent than the specific water use objective for the same parameter in another jurisdiction. For example, Alberta's objective for chromium is 0.05

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* In *A Policy for Resource Management of the Eastern Slopes, Revised 1984*, "goal" is defined as "an end to be striven for but not necessarily achievable," while an objective is defined as "a clear and specific statement of planned results to be achieved."

mg/L compared with the 0.04 mg/L federal objective for aquatic use; for copper Alberta's objective of 0.02 mg/L is one-tenth as stringent as the Federal objective of 0.002 mg/L for aquatic use; the objective for lead is 0.05 mg/L compared with a Federal objective of from 0.005 to 0.03 mg/L depending on the species and water hardness. However, Alberta's objectives are sometimes more stringent than the Federal objectives. For example, Alberta's general objective for arsenic is 0.01 mg/L while the Federal arsenic objective for aquatic life is 0.05 mg/L.

The Surface Water Quality Objectives (see Appendix B) establish "minimum water quality guidelines which would allow the most sensitive use" (Alberta Environment 1977a: 3). These uses, which require "the highest quality of water with the minimum allowable variance" (Alberta Environment 1977a: 3), are identified as "water for public water supply, recreation involving direct water contact, wildlife and aquatic life protection" (Alberta Environment 1977a: 3). By allowing the most sensitive use, "all other demands involving lesser quality or demands more tolerant to wider variation would also be satisfied" (Alberta Environment 1977a: 3). The objectives have been developed in the context of addressing long-term, subtle changes in water quality and cumulative interaction among the physical, chemical, and biological components of the aquatic ecosystem; this interaction may disrupt the watershed and the life it contains. It is stated that assessment of the quality of a water body is complicated, partially subjective, and limited by our present state of knowledge. Nevertheless, even though the objectives are imprecise, "some minimum levels of quality are needed below which no water body is permitted to deteriorate" (Alberta Environment 1977a: 1).

The water quality objectives recognize that natural levels of contaminants may exceed provincial objectives. In these cases, it is not the intention to revise the objectives to account for particular situations; individual occurrences will be treated as special cases and reviewed accordingly. "The surface water quality objectives apply to all surface waters in Alberta" (Alberta Environment 1977a: 4). Where the natural water quality falls below the objectives, "it would be unwise to permit further deterioration by unlimited or uncontrolled introduction of pollutants" (Alberta Environment 1977a: 5). The water quality objectives apply "to surface waters except in areas of close proximity to outfalls" (Alberta Environment 1977a: 5). The objectives were written in this manner to provide a statement of general criteria but at the same time provide recognition that objectives are not carved in stone (Milos 1985: pers. comm.).

The document does not explain how the objectives will be "applied" by the Department nor how they relate to the responsibility of the Standards and Approvals Division to licence releases of environmental contaminants under the Clean Water Act, except to state that "the numerical objectives provide a basis for determining the capability of a receiving water course to assimilate water contaminants..." and "waste load allocations for end of pipe discharges can be budgeted upon implementation of best practicable control technology and industrial performance guidelines in conjunction with consideration of these ambient surface water quality objectives" (Alberta Environment 1977a: Foreword).

These statements suggest two important interrelationships: first, that the objectives may bear a direct relationship to protection of the aquatic environment and, second, that licensing of waste discharges will be related to the objectives and hence to the ambient water quality.

The stated intent was to review and revise the objectives periodically "as a result of advances in the technology of water purification and waste water treatment and changes in water quality requirements for the preservation of our environment" (Alberta Environment 1977a: Foreword). The numerical objectives are, therefore, at least in part a function of control technology rather than purely a statement of empirical criteria necessary to protect the most sensitive use of the water body. The document does not discuss how the objectives were determined nor does it contain, except for brief general comments, any evidence or rationale to support the objectives chosen. According to Franson et al. (1982), this is common; the decision-making, rationalizing, and judgmental steps in determining objectives are not usually clearly identified. The numerical values for objectives often are selected through an in-house technical operation, with no public discussion.

One difficulty noted in reviewing the Surface Water Quality Objectives was the lack of clarity in the identification of a purpose or goal for the objectives. For example, it is unclear what will be the result if the numerical objectives listed in the document are maintained or achieved, nor is there an indication of how the province is going to proceed towards achieving these objectives. The Surface Water Quality Objectives document provides little indication of goals and means, and therefore its purpose and role may be subject to misinterpretation.

The approach to water quality management in Alberta seems to be changing from the approach identified in the Surface Water Quality Objectives, of protecting the most sensitive use, towards the concept of beneficial use. Beneficial use is an approach by which the numerical value of the water quality objectives depends on the use of the water, for example, domestic consumption, recreation, or industrial use, instead of having a single set of objectives whose goal is to protect the most sensitive use.

The beneficial use concept is embodied in a stream classification system developed in Manitoba. The stream classification

> *...recognizes the disposal of waste as a useful function of a stream which can be harmonized with other uses and which, depending on the circumstances, may have to take priority over other uses* (Manitoba 1979: 11).
>
> *Stream classification is, therefore, a policy decision, a commitment towards maintaining certain minimum standards of environmental quality that will ensure that valued uses may continue in the future or that they may be restored* (Manitoba 1979: 9).

Manitoba has been holding public hearings since 1979 to develop classifications for streams and sections of streams in each of 19 "principal watershed divisions." The acceptance of a stream classification system in Alberta would mean a complete revision of the surface water quality objectives as they currently exist.

A statement of this concept appears in *Water Resource Management Principles for Alberta* (Alberta Environment n.d.a), which states that the provincial strategy is to obtain "from the water resources a maximum benefit for Albertans while ensuring that the water is in a condition for beneficial use for an indefinite period" (Alberta Environment n.d.a: 9).

The new interim water quality requirements for the Beaver River in the Cold Lake Area (PPWB 1979) also indicate a shift toward the concept of beneficial use. The interim water quality requirements are more lenient than the 1977 objectives. The 1977 objectives state that where natural water quality is inferior to the desired objectives, "it would be unwise to permit further deterioration by unlimited or uncontrolled introduction of pollutants" (Alberta Environment 1977a: 5). While effluent releases in the Beaver River will not be unlimited or uncontrolled, the need to modify the objectives stems from a desire to accommodate industrial and municipal growth in the area; that is, the water quality objectives reflect the "beneficial" use of that water.

In the South Saskatchewan River Basin Planning Program, consideration also is given to the beneficial use concept. People were asked to provide input on water quality use objectives, describing a desired quantity or quality of water in a number of categories such as agricultural, recreational, municipal/domestic, industrial/hydro, and environmental. The beneficial use concept was to be applied to quantity as well as quality of the water.

Staff within Alberta Environment have also indicated that, while they try to minimize pollution, they recognize that various uses of water are competitive and that sometimes uses have to be balanced instead of the most sensitive use being protected.

For example, J.R. Milos has stated that the surface water quality objectives

> *...have to be a compromise between all of the competing uses and as such no one use can generally be totally satisfied to the exclusion of all else. We in the department have made an attempt to try to satisfy as many uses as is possible without undue hazard or exclusion of competing uses* (Milos 1985: pers. comm.).

The Clean Water Act makes provision for a stream classification system. The Act authorizes the Lieutenant Governor in Council to "establish and classify the use of water in Alberta and the use and classification of all or any water courses" (s. 21(g)). The approach might be analogous to a land use classification system in which certain land areas are designated for commercial, industrial, residential, or agricultural uses. Indeed, a stream classification system would have to be fully integrated into land use classification systems and the planning processes (that is, regional and municipal planning) to be effective.

THE EXAMPLE OF ONTARIO

It is useful to study Ontario's *Water Management – Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment* (Ontario Environment 1984) as an alternative approach and perhaps a model for Alberta. This document deals with water quality and quantity for both groundwater and surface water. It clearly spells out Ontario's goals, policies, implementation procedures, and anticipated results.

The goal for water quality is "to ensure that surface waters of the province are of a quality which is satisfactory for aquatic life and recreation" (Ontario Environment 1984: 4). This goal is explained as follows:

> *Water which meets the water quality criteria for aquatic life and recreation will be suitable for most other beneficial uses, such as drinking water and agriculture. For the few parameters where better water quality is required to protect these other beneficial uses in a given location, the appropriate criteria shall be applied in that location* (Ontario Environment 1984: 4).

This is similar to the explanation accompanying Alberta's objectives, but in Ontario it is clearly identified as a provincial goal. The Ontario document later expands the explanation of what the objectives will achieve and how they were derived. "The Objectives for protection of recreational water uses are based on public health and aesthetic considerations" (Ontario Environment 1984: 10). The Objectives for aquatic life "are set at such values as to protect all forms of aquatic life and all aspects of the aquatic life cycles. The clear intention is to protect all life stages during indefinite exposure to the water" (Ontario Environment 1984: 10).

There are five important policy statements with respect to achieving these goals:

1) Where water quality is better than the objectives "water quality shall be maintained at or above the Objectives" (Ontario Environment 1984: 4).

2) In areas where water quality does not meet the objectives, water quality "shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives" (Ontario Environment 1984: 5).

3) "Effluent requirements will be established on a case-by-case basis. In establishing effluent requirements, the characteristics of the receiving water body will be considered, as will Federal and Provincial effluent regulations and guidelines where applicable" (Ontario Environment 1984: 5).

4) "Special preventative measures are required to deal with the release of known or potentially hazardous substances" (Ontario Environment 1984: 5).

5) "A mixing zone is defined as an area of water contiguous to a point source where the water quality does not comply with the Provincial Water Quality Objectives" (Ontario Environment 1984: 5). Terms and conditions related to a mixing zone will be designated on a case-by-case basis, but the size of the mixing zone shall be minimized to the greatest possible degree and under no circumstances is the mixing zone to be used as an alternative to treatment.

These policy statements are accompanied by specific descriptions of implementation procedures which spell out the intent of the water management policies.

Alberta's Surface Water Quality Objectives contain many similar ideas with respect to water quality management, but these ideas are not stated as matters of provincial policy, nor is the process to achieve the objectives spelled out. The lack of a clear statement of policy for water quality management can lead to public misunderstanding of provincial efforts in water quality protection as well as uncertainty among industry and municipalities about future effluent quality goals. To bring Alberta to the level of Ontario would require redrafting of the Surface Water Quality Objectives to provide a clear statement of goals for

water quality, the numerical objectives that should achieve these goals, and a statement of policies and guidelines that will lead toward them.

Even though an explicit statement of policy does not guarantee the attainment of the goals as outlined, it makes the public and all water users more aware of the Government's intentions and provides a clear standard against which success in implementation and enforcement can be judged.

POLICIES FOR ALBERTA

The 1977 Surface Water Quality Objectives supersede the Surface Water Quality Criteria (1970) prepared by Water Pollution Control Section of the Department of Health. (This section was incorporated in the Department of the Environment upon its formation in 1971). The 1977 "objectives" and the 1970 "criteria," however, are identical except for the additional requirement in the 1977 objectives — that pesticides must be registered and approval granted if they are to be used on, in, or near water.* Hence, objectives developed in 1970 are still applicable to Alberta's surface water in 1985.

Although the numerical objectives were the same in 1977 as in 1970, the text supporting the objectives was completely rewritten. The 1970 "criteria" document, in fact, contains a more explicit statement of the province's goal for water quality. The purpose of the water quality management criteria in 1970 was

> *...to conserve water and to protect, maintain and improve its quality for the protection of public health and, within economic limits, for the following purposes:*
>
> *a) preservation and protection of water supplies;*
>
> *b) encouragement of economic development;*
>
> *c) preservation of aesthetic values; and*
>
> *d) preservation of fish and wildlife*
> (Alberta Department of Health 1970: 2).

There is, however, no explanation of procedures which would be followed to ensure that these objectives are achieved.

During the preparation of this report and through conversation with Alberta Environment staff, it became clear that the Surface Water Quality Objectives represent "idealistic hopes" of the Department with respect to water quality. Given the general nature of statements within the document, this is not surprising. Without the provision of policies regarding the

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*Due to an oversight, the 1977 objectives did not contain the objective of 200 coliform organisms per 100 mL for fecal coliform density in water used for direct contact recreation or vegetable crop irrigation. Some copies of the published objectives do not contain the addendum correcting this oversight.

application and implementation of the Surface Water Quality Objectives, Alberta Environment staff must seek elsewhere for direction for their programs for the prevention and control of pollution. This direction is provided through policy statements in the Water Resource Management Principles for Alberta and in the Role and Mission statement of the Department.

The Water Resource Management Principles for Alberta have been developed "within the overall framework of Provincial goals and objectives and are being applied as guidelines for water resource management" (Alberta Environment n.d.a: 2). The principles, therefore, provide direction on how provincial "goals" might be achieved, but are not statements of these goals. With respect to water quality, Principle No. 11 states that "the Government is committed to a program to prevent or control water pollution. Water quality objectives, at least as stringent as those set nationally in Canada, have been defined and apply to all surface water bodies" (Alberta Environment n.d.a: 12).*

This Principle also serves as the purpose of the Pollution Prevention and Control program of Alberta Environment in the Department's Role and Mission statement (Alberta Environment 1977b). The purpose of that program is "to prevent or control pollution in order to protect the environment and the quality of life" (Alberta Environment 1977b: 5). This role statement is supported by a list of nine operational policies and guidelines for the implementation of the programs:

1) *To be effective, pollution must be controlled at its source.*

2) *The polluter must generally pay for the cost of cleaning up his pollution...and bear the burden of direct cost arising from that pollution.*

3) *Preventing pollution is a direct responsibility of any enterprise causing it...and the government sees no just cause or purpose that is served by offering direct monetary grants to industry for installation of pollution control equipment or facilities.*

4) *It is our design to be preventative...to work with industry in effecting the ultimate in pollution control and natural resource management...to enhance the livable environment.*

5) *To control pollution at the source, enterprises must adequately monitor their pollution streams and report the details to government periodically.*

6) *It will be this government's policy to impose pollution source standards of such initial severity as to prevent the need for revision of the standards at frequent intervals.*

7) *To establish source emission standards for the various industries in Alberta it has been necessary for us to treat each industry individually and assign priorities in this respect.*

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* It is not clear whether Alberta's Surface Water Quality Objectives are the objectives referred to in this Principle, but the Surface Water Quality Objectives do not cover as many elements as some produced by the Federal government (see Environment Canada 1979).

8) *We would not, under any circumstances, sanction standards in Alberta less stringent than those set by E.P.A. in the United States or those set nationally in Canada.*

9) *It is the intent of the government to examine the need for green belts and/or limiting polluting industries from locating in industrial clusters...in order to protect existing industries from being "squeezed"...too often to maintain ambient standards* (Alberta Environment 1977b: 5-6).

These policies and implementation procedures direct the activities of the Department related to water quality protection and, hence, define the role of the Clean Water Act. The focus of the Clean Water Act thus becomes the control and regulation of contaminant releases – or, in other words, the prevention of pollution. There is little direction requiring the Clean Water Act to focus on protection of the environment. The Surface Water Quality Objectives provide an idea of the end point, an idea of how the "quality of life" might be measured, but they do not determine the role of the Clean Water Act.

DEVELOPING OBJECTIVES

To better understand objectives and how they are determined, it is useful to examine the existing literature.

The following discussion relies heavily on *Guidelines for Water Quality Objectives and Standards: A Preliminary Report* (Environment Canada 1972) and on *Quality Criteria for Water* (EPA 1976). Environment Canada is continuing to release chapters of guidelines for surface water quality. The first of these has been published as *Guidelines for Surface Water Quality* Volume I (Environment Canada 1979), a detailed document which builds on the Preliminary Report and advances in knowledge since 1972. The new guidelines are to be published in three volumes dealing with inorganic chemicals, organic chemicals, and physical, microbiological, and radiological characteristics.

There are several reasons why objectives are set for the concentration of substances in surface water. Some substances are significant because of their impact on aesthetic quality, some because of potential impact on human health, and others because they may affect aquatic life. Some substances are bio-accumulative (they accumulate in living materials), some have short-term toxic effects, and others have long-term chronic effects. The microbiological parameters, coliforms and fecal coliforms, have limits not because they are harmful in themselves, but because they are indicators of recent fecal contamination and could be accompanied by pathogenic micro-organisms. Often there are different objectives for parameters depending on differing uses of the water. Alberta has general objectives to protect all uses.

Objectives may be given in different formats:

1) maximum changes from the background or natural level,

2) a factor of some standard measure of toxicity such as TLm (median tolerance limit), or LC_{50} (concentration lethal to 50 percent of the total organisms), or

3) maximum or minimum limits.

Based on these formats, there might be a series of levels depending on the degree of protection desired, which is determined by a subjective evaluation of the amount of deterioration from the pristine condition which might be permitted or the "use" to be protected. The concept of "ecosystem level of protection," pervasive in Environment Canada's 1972 Guidelines, uses four "degrees of protection," with values (numerical objectives) being specified for each. The degrees of protection offered range from Level I (maximum, that is, pristine or natural state of ecosystem and water quality), through Level II (high) and Level III (medium) to Level IV (minimum protection, that is, at the threshold of harmful effects and providing no margin of safety — the so-called "T" value). Level IV corresponds to water quality in discharge zones and other areas where only maintenance of minimum functioning of the ecosystem is possible. This concept offers "a highly flexible and useful tool providing protection agencies with clear-cut alternatives from which they may choose in order to set standards in any type of water body" (Environment Canada 1972: 88). The concept also incorporates the principle "that as the level of a harmful factor increases the measurable changes in the ecosystem will generally increase exponentially" (Environment Canada 1972: 88). "Hence any water body with a pollutant concentration close to 'T' is indeed in a precarious position" (Environment Canada 1972: 88).

The first format (using an objective expressed as an acceptable level or amount of change from the background or natural level) is frequently used for physical variables. Alberta uses this approach for suspended solids, temperature, odor, color, and turbidity. It is also used by Alberta in combination with numerical limits to determine an objective for the pH of surface water. The basis for this approach is the assumption that the present aquatic ecosystem is the desirable one and the existence of this ecosystem depends on maintaining, within a restricted range of variation, the "natural" condition for a number of parameters.

Several factors must be considered in the formulation of objectives using this format. For example, how are "ambient" or "background" or "natural" levels determined? Do these terms mean the same thing? How do objectives consider the short-term and long-term effects and the impact of sudden changes in the concentration of pollutants? Since species sensitivity depends on time of year, species, and acclimation, as well as other factors, can the objectives adequately protect an existing natural ecosystem?

A second common format for objectives is limits established in relationship to the LC_{50} (the concentration of a toxicant which is lethal to 50 percent of the organisms tested for a specified time, usually 96 hours), or TLm or TL_{50} (the concentration at which just 50 percent of the organisms are able to survive). This approach sometimes is used for toxic chemicals such as non-bioaccumulative heavy metals and pesticides. The development of objectives utilizing LC_{50} or TLm must consider factors such as: variation in local water conditions (for example, pH, hardness, temperature) which likely necessitates site-specific bioassays; mixtures of pollutants having additive, synergistic, or antagonistic effects; variation in species sensitivity; and the fact that if the concentration of a pollutant fluctuates, the most toxic level attained is more influential than the average in governing effects on fish.

The third format is a specific limit, usually a maximum, although minimums may be stipulated.

The use of single or multiple maximum levels as objectives, although common, entails a number of difficulties. The information base is usually developed from laboratory studies,

the results of which cannot accurately be extrapolated to natural conditions. Factors such as pH and temperature influence the effect of a substance, but probably of greater importance are reactions with other ions in the water. Many chemicals have varying effects depending on their ionic form and consequent solubility. Hardness, a measure of the dissolved ionic concentrations, in particular influences toxic and chronic effects. Another factor is the influence of other pollutants — do they react additively, synergistically, or antagonistically? Alberta's objectives (Alberta Environment 1977a) provide no guidance on how to treat combinations of pollutants. A single maximum limit for a substance may not adequately reflect the complex interactions that occur in aquatic ecosystems. However, the development of an objective is considered essential and a numerical objective is developed, even though our understanding of the complex interactions is rudimentary. The frequent use of "1," "2," and "5" as numerical values indicates that objectives are not based strictly on analytical results. This is at odds with the impression of accuracy given by the use of several significant digits, for example, phenolics — 0.005 mg/L, which may create unrealistic expectations among the public of the level of scientific certainty about the effects of trace levels of contaminants.

Objectives based on a fraction of the TLm or a maximum acceptable concentration of a contaminant in the aquatic environment represent a different philosophical approach than objectives based on an allowable variance from natural conditions. Objectives based on acceptable concentrations suggest that water bodies may be contaminated with impunity until a given level has been reached. This further suggests that all water bodies ultimately could reach the same level of contamination. There are some obvious drawbacks and limitations to this system of controlling water quality, if the goal is to maintain variability in aquatic ecosystems. These limitations are avoided when objectives are based on an allowable variance from natural conditions and to some extent are recognized by the use of "levels of protection" (Environment Canada 1972) and the acknowledgement of the inadequacies of objectives with respect to protecting all species, in all habitats, throughout the United States (EPA 1976). Nevertheless, despite these difficulties, most jurisdictions have ambient surface water quality objectives based on numerical formats. How have these objectives been determined?

The approach used by Environment Canada has been documented. According to Demayo and Taylor (1980), impetus for development of objectives includes such factors as political decisions as a result of a government policy or in response to a particular situation, technical or scientific reasons, or public opinion. In the formulation of Environment Canada's objectives, the first step is to gather research information. This information is screened, reviewed, assessed, and analyzed. The objectives are based on the "best available scientific information." However, because of the complexities of aquatic ecosystems, there are limitations to the usefulness and adequacy of the data. The suitability of the method, the planning of the experiment and the statistical analysis, whether or not the experiments were relevant to the Canadian environment, and whether or not all factors such as water quality and viability of the organisms have been included, are considered (Demayo and Taylor 1980). Important to the delineation of objectives are data on the distribution and transfer rates of a substance between "compartments" of an ecosystem (for example, sediment-water-air), chemical and physical forms, synergism and antagonism, stress and acclimation, and sublethal effects (Demayo and Taylor 1980). Despite the seeming wealth of scientific information, adequate operational information is often lacking. In particular, information about aquatic organisms

is important since objectives protecting aquatic life are "usually the most stringent and quite often are at least one order of magnitude lower than those for human consumption" (Taylor 1979: 96). Unfortunately, most experiments seek to determine acute toxicity or lethal effects. Results of these experiments are of limited use when setting objectives.

> *Water quality objectives can be proposed with more confidence if information is available for a number of groups of organisms and for responses which include life cycle studies, or at least that part of the life cycle known to be the most sensitive. The range of concentrations used should include one which has no discernible effect* (Taylor 1980: 27).

In addition, the use of a constant concentration in laboratory studies is not always realistic when compared with fluctuating levels of exposure under natural conditions.

After all information has been reviewed and analyzed, Environment Canada staff prepare a draft report. This report uses scientific information as well as information about natural water quality and recommends objectives for different water uses. The report is reviewed by specialists in various scientific fields that may be affected by implementation of the objectives, such as health, agriculture, and fisheries. "After a final assessment, the guidelines are then redrafted and tabled before the federal government interdepartmental committee on water (ICW), to ensure that all interdisciplinary requirements are met" (Taylor 1979: 94).

It is important to reiterate that objectives represent scientific judgments and scientific evidence, tempered by value judgments and subjective decision-making. Value judgments are necessary because the complex interactions that occur in the aquatic environment make it impossible to develop objectives that can adequately describe water quality goals for all substances and all water bodies under all conditions. Objectives "should not be used as absolute values for water quality but with considered judgment and with an understanding of their development" (Environment Canada 1979: iii).

Objectives must necessarily be simplified statements. However, Alberta's objectives seem overly simplified, possibly reflecting their 1970 origin and the lack of updating and modernization to incorporate advances in knowledge and changing public awareness in the intervening years. Alberta provides no formal opportunity for public input to the value judgments. "Judgments are made in consultation with industry, municipal officials, technical experts, literature information, etc." (Defir 1983: pers. comm.). This is, at present, also the approach taken by Environment Canada. However, the recently developed policy for public consultation and information availability will require that "all significant new regulations and guidelines be subject to an explicit procedure that allows for public comment at all stages of their development" (Environment Canada n.d.: Preface). This policy has not yet been fully implemented, but actions of Environment Canada indicate that members of environmental organizations and other concerned individuals will be provided with the opportunity to assist in development of water quality objectives. The involvement of the public in the process of setting standards and objectives should be encouraged both federally and provincially. The public have a valuable role to play in guiding water quality managers and governments with respect to the value judgments inherent in environmental protection. Technical expertise in pollution control is no guide to a balance between resource development and environmental protection. Such judgments require policy based on a broad range of points of view. In Alberta, the South Saskatchewan River Basin Planning Program is a beginning in the process of involving the public in decisions about the future of water quality.

To summarize, objectives are, in essence, a list of numerical values based on scientific and value judgments which, if not exceeded, should protect aspects of a water body such as recreational value, aquatic habitat, or usefulness for industry. Objectives are not a statement of an agency's goals or policy nor a mechanism for implementation of that policy. Objectives are not enforceable standards, though they are essential to the development of enforceable standards.

6. Regulations Pursuant to the Clean Water Act

The Clean Water Act empowers the Minister of the Environment to make regulations prescribing the rate, amount, and concentration of discharges of water contaminants from any water facility and prescribing ambient concentrations for water contaminants (s. 2). The Lieutenant Governor in Council may make regulations governing applications for permits and licences and exempting a source of water contaminants from the provisions of the Act (s. 21).

To date, four relevant regulations have been made:

Clean Water (General) Regulations (AR 35/73 with amendments up to and including AR 408/84)
Clean Water (Industrial Plants) Regulations (AR 36/73)
Clean Water (Municipal Plants) Regulations (AR 37/73 with amendments up to and including AR 83/82)
Stop Order Appeal Regulations (AR 9/74)

These regulations mainly stipulate requirements for permits and licences and detail the appeal process for a stop order.

No regulations have been issued by the Minister for either ambient water quality or effluent discharges. There are objectives for ambient water quality and guidelines* for effluent discharges, but neither are established in regulations. The approach of the Department is to control the release of contaminants from water facilities through conditions attached to a licence to operate.

CLEAN WATER (GENERAL) REGULATIONS

The Clean Water (General) Regulations exempt certain water facilities and authorize certain activities by the Minister of the Environment and the Directors of Standards and Approvals and Pollution Control. As well, the regulations authorize the Minister to issue guidelines or criteria, detail reporting requirements following spills or unauthorized releases of contaminants, and stipulate a general prohibition of releases of contaminants.

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* In reviewing water quality management documents, it becomes obvious that there is no consistency in terminology referring to what is expected with respect to contaminant levels in surface waters or effluent discharges. Terms such as "criteria," "objectives," "guidelines," "targets," "recommended standards," and "requirements" all are used. Throughout this report the terms used are those used in the document under discussion.

Section 2 of the regulations exempts: certain potable water works systems not connected to a municipal plant; sewerage projects utilizing sewage fields, leaching cesspools, or No-Dac filters; single family swimming pools; and thermal electric power plants not discharging effluent to a watercourse from requirements for permitting and licensing as stipulated in the Act and from regulations made pursuant to the Act.

Also exempted are water facilities* during repair and maintenance. Owners or operators of such facilities are exempted from the need to obtain a permit, licence, or amendment to a licence in order to initiate repairs or maintenance. If the facility is licensed, the terms of that licence still apply to the facility during repair and maintenance.

Any industrial plant that discharges all of its contaminants to a municipal plant also is exempted and does not need to obtain a permit to construct or a licence to operate. This particular exemption shifts the responsibility for the control and clean-up of industrial discharges to the municipality.

The General Regulations also authorize the Minister to expropriate land if necessary to carry out provisions of the Act (s. 3), authorize the Director of Standards and Approvals to order improvements or modifications to any water facility (s. 4(1)), and authorize the Director of Pollution Control to order repair or proper operation of any water facility (s. 4(2.1)). It is an offense, liable to a fine of up to $1,000 per day, not to comply with an order issued in accordance with Section 4.

Section 6 authorizes the Minister to issue guidelines concerning the construction or operation of any water facility. The industrial waste water effluent guidelines have been issued under this provision.

An important requirement of Section 9 of the General Regulations is that if any accidental spill or discharge or any controlled release not authorized by a licence occurs at a water facility, it must be reported to the Director of Pollution Control within 24 hours of its discovery and a written report filed within 72 hours. It is an offense not to file such a report and the offender is liable to a fine of up to $1,000 for each day that the contamination continues. As mentioned earlier, spills of oil or salt water at well sites or batteries are reported to the ERCB and clean-up of such spills is done under the direction of the ERCB.

Section 9 applies to an accidental release such as a pipeline breakage, a process upset, or a valve accidentally left open, as well as to circumstances when normal effluent treatment may be temporarily bypassed, for example, due to equipment failure in the treatment system, equipment maintenance, or bypassing of municipal sewage treatment plants during peak flows when the plant cannot handle the surge.

The General Regulations also contain a general prohibition that "no person shall, without the written permission of the Director of Standards and Approvals or the Director of Pollution Control discharge...or allow to be deposited upon the banks of or into any reservoir, surface water, or watercourse any substance capable of changing the quality of the water or causing water contamination" (s. 11(1)). To do so is an offense liable to a fine

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* A "water facility" is any plant, structure, or thing that may be a source of water pollution.

of not more than $1,000 for each day that the contravention continues. This general prohibition and the prohibition in the Clean Water Act apply to all sources of water contamination regardless of the previously discussed exemption clause.

The Clean Water (General) Regulation contains three clauses which in particular affect the Department's approach towards water quality management: Section 2, the "exempting" provision; Section 9, the "reporting" provision; and Section 11, the "general prohibition" provision.

The general prohibition clause in the Clean Water Act is substantially different in wording from the prohibition clause in the Clean Water (General) Regulations. The prohibition clause in the regulations refers to "substances capable of changing the quality of the water or causing water contamination." No reference is made to this resulting in water being rendered "harmful to human health or life, fish, wildlife, livestock or plants," as stated in the Act. The legal implications are not clear, but it appears that Section 11(1) of the General Regulations may have a broader application than provided for in the Act. The legal intent of these two clauses needs to be clarified and any ambiguity removed.

The important aspect of the "exempting" provision is that it moves the direct control of industrial wastes discharged to municipal sewage systems from Alberta Environment to the municipality. Alberta Environment maintains indirect control over these discharges through its control over municipal effluent discharges. However, it is the responsibility of the municipality to regulate and control those industries discharging into municipal sewers. The efficiency and cost-effectiveness of this approach is inhibited by the difficulty, for both economic and political reasons, of the provincial government taking strict enforcement action against municipalities.

Although there are no regulations which prescribe limits for the concentration of discharges of contaminants, or their concentration in surface waters, releases of contaminants by non-licensed operations or individuals can be controlled under the general prohibition clause. This clause could be used to control contaminant releases by either licensed facilities or non-licensed sources, but is most useful with respect to non-licensed sources. Other provisions of the Act, such as offenses for violation of a condition of a licence, are directly applicable to licensed facilities and may be easier to enforce. No charges have been brought against industry under the general prohibition clause since 1975 (Alberta Environment 1984a).

The use of the general prohibition clause in the Clean Water Act or in the regulations to prosecute individuals for unauthorized releases is difficult. Such releases are often single occurrences, whether deliberate or accidental, and often become known to the Department of the Environment only as a result of complaints by the public after the fact. Proving an offense is extremely difficult. Detecting such occurrences through departmental monitoring is unlikely, and collecting sufficient evidence to meet the judiciary's requirements poses difficulties. As a result these provisions have never been used to lay charges against individuals under the Clean Water Act. Releases by individuals are therefore only loosely controlled by the existing legislation and enforcement practices. Problems are corrected by following up complaints with discussion between the Department officials and the persons involved.

Of a more serious nature are periodic releases of contaminants to surface water. Activities which fall into this category are agricultural livestock operations, irrigation drainage systems,

and storm water runoff. While these operations might be controlled through licensing or through application of the general prohibition clause, no action has been taken to date. The reasons seem to be concern over infringement on individual operations such as livestock operations or irrigation drainage systems, and reluctance to impose costly requirements upon municipalities for control of storm water runoff, as well as the very practical difficulty of regulating diffuse releases from a multitude of sources. Yet these uncontrolled sources have the potential to have a substantial impact on surface water quality. Several reports have indicated the need for better control and management of these sources of contaminants (Maruschak 1983, Reynoldson and Livingstone 1983, Oldman River Basin Study Management Committee 1978). The management of these sources of water contamination is a growing problem. Increased development in Alberta could lead to growing problems with uncontrolled contamination sources. A pro-active approach by the Department could avoid or mitigate these potential problems.

Since Alberta Environment does not conduct extensive monitoring, the Department depends heavily upon the provision of accurate information by the operators of water facilities in order to be aware of the extent of excursions and other unauthorized releases. The reporting of unauthorized releases, therefore, becomes critical and the Department treats any failure to report uncontrolled or unlicensed emissions as a serious violation of the regulations. Non-reporting of emissions likely will result in a recommendation to the Attorney General to prosecute (Alberta Environment 1984a). The regulations, however, do not specify that the Director of Pollution Control is required to take any action in response to information filed by a facility operator. Follow-up by Alberta Environment is at the discretion of the Director of Pollution Control.

CLEAN WATER (INDUSTRIAL PLANTS) REGULATIONS AND CLEAN WATER (MUNICIPAL PLANTS) REGULATIONS

The Clean Water (Industrial Plants) Regulations detail how to make applications for permits, licences, and amendments to a permit or licence. The Clean Water (Municipal Plants) Regulations contain similar requirements but also specify that all municipal plants must be designed to meet the Recommended Standards for Water Supply and Sewerage (Alberta Environment 1978b) or to a standard required by the Director of Standards and Approvals, and obtain a permit and a licence to operate. A municipal plant is defined in the Regulations as a water works system, a waste water treatment facility, or a sewer or sewerage project, that is not an industrial system, facility, or project and that is not exempted under the Clean Water (General) Regulations.

The Recommended Standards require that the water delivered to consumers meet the current requirements of the Director of Standards and Approvals with respect to bacteriological, physical, chemical, and radiological qualities. The Guidelines for Canadian Drinking Water Quality 1978 (Federal-Provincial Working Group on Drinking Water 1979) are used as a guide. A review of these guidelines is underway and new guidelines are expected in 1985. The working group is reviewing a number of the chemical parameters such as arsenic, lead, antimony, copper, asbestos, and pesticides and is also considering guidelines for some additional organic chemicals. These guidelines apply to any public water supply which requires approval by Alberta Environment. This encompasses all public water supplies except for single family dwellings, or hotels or restaurants where the water supply comes

from private systems, that is, wells. The provision of potable water in these instances is the responsibility of the Local Board of Health in accordance with the Provincial Board of Health Regulations Respecting Water Supplies (AR 346/71*) under the Public Health Act.

With respect to drinking water quality, the Municipal Plants Regulations state that if the water is obtained from a surface water source, the owner of a water works system must submit at least two samples of treated drinking water each year to the Department of the Environment laboratory for analysis. One sample is to be taken in the summer and one in the winter. As well, a minimum number of samples, as specified by the Guidelines for Canadian Drinking Water Quality (latest edition), must be analyzed by an "approved" laboratory (one approved by the Director of Pollution Control). The chemical and bacteriological quality of water in a municipal water supply must meet the requirements of the Guidelines. Requirements for disinfection of municipal water supplies are contained in Sections 25 and 26 of the Regulations.

STOP ORDER APPEAL REGULATIONS

The Stop Order Appeal Regulations basically reiterate the stop order appeal process described in the Act (see Chapter 4) and provide a sample appeal form.

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* With amendments up to and including AR 284/78.

7. Effluent Guidelines

The regulations do not prescribe standards (legal limits) for effluents of municipalities or industrial plants and, therefore, are not intended to be the main mechanism for control of pollution. Instead, effluent guidelines have been developed (Appendix C) which by themselves are unenforceable but which become binding if stipulated as a condition of an operating licence. The effectiveness of the Clean Water Act, therefore, hinges on the permit and licence system. However, the effluent guidelines, since they are generally incorporated into permits and licences, are an important component of pollution control.

INDUSTRIAL WASTE WATER EFFLUENT GUIDELINES

The objectives of industrial waste water effluent guidelines (as stated in the guideline documents) are: (1) to reduce the quantity of contaminants in the liquid effluent, (2) to reduce the quantity of effluent, (3) to encourage operators to install pollution control equipment which represents the best practicable technology, and (4) to develop plant emission limits that reflect the capability and efficiency of this best practicable technology (Alberta Environment 1976a, 1976b). This is in keeping with the general direction of the pollution control programs of Alberta Environment. Coal mining waste water effluent guidelines, which are related to surface mining operations rather than to the operation of an industrial plant, do not contain these last two objectives. In their place is a third objective: "c) guide coal mine operators as to the relevance of The Clean Water Act" (Alberta Environment 1978a: 1).

Industrial waste water effluent guidelines are developed and reviewed by Alberta Environment and representatives from the concerned industrial group based on a review of the industrial group's processes, practices, and control technology. In the case of guidelines for brine storage reservoirs, the Energy Resources Conservation Board was also part of the task force. The guidelines published to date are listed in Appendix C.

The expected levels of water quality are based on best practicable technology, defined as "control technology which has been used successfully in a commercial installation for a reasonable period of time" (Alberta Environment 1976b: 2). Guidelines usually specify effluent releases both as permissible concentrations and as quantities based on nominal plant effluent discharges. Guidelines are specific to an industrial group and mandatory for all new operations in that group. The specified parameters and minimum levels vary, however, depending on the industrial group and the contaminants most likely to be released. Because

industrial processes, water consumption, and best practicable control technologies differ among industrial groups, different levels of contaminant release are permitted for different industries. For example, the maximum average concentration for ammonia-nitrogen in effluents from petroleum refineries is 12.5 mg/L whereas from fertilizer plants it is 35 mg/L.

As well as providing limits for the release of certain contaminants, the guidelines also specify what is expected of the plant operator with respect to sampling frequency, monitoring of effluents, reporting of monitoring information, and other conditions related to monitoring. There is often a requirement for an acute toxicity test on the effluent waters as well as sampling for specific parameters.

The guidelines were developed on a priority basis for the major industries in Alberta beginning with the gas processing industry in 1973. The guidelines apply only to new plants; the need for upgrading of existing facilities is considered on an individual basis at the time of licence renewal.

Guidelines usually become incorporated into a licence to operate and determine the maximum levels of contaminant release a company is allowed under its licence. For example, the petroleum refineries effluent guidelines state that "permits or licences for petroleum refining operations will be issued by the Director of Standards and Approvals only if there is provision for a program for treatment to achieve the standards contained herein" (Alberta Environment 1976a: 1).

The guidelines, however, usually specify levels for "traditional" parameters only. The guidelines for petroleum refineries specify limits (both concentration and amount) for chemical oxygen demand (COD), oil and grease, total suspended solids, phenols, sulphide, ammonia nitrogen, threshold odor number, and pH. A monthly bioassay fish toxicity test is also required. If the bioassay indicates acute toxicity of the liquid effluent, then surveys of chromium, cyanide, lead, mercury, zinc, and nickel may be required. Requirements for other parameters may be added to the licence at the discretion of the Director of Standards and Approvals.

For a few industries, the permitted levels of contaminants in the waste water effluents are additive to the levels of the ambient (incoming) water (Alberta Environment 1976b). For example, the fertilizer plant guidelines state

> *It is intended that the deposit limits on contaminants will only apply to the amount of the contaminants contributed by the fertilizer operations (the "net value" concept). Therefore it may be necessary to determine the amount of a water contaminant contained in the intake water to arrive at a net value* (Alberta Environment 1976b: 15-16).

These particular guidelines consider the levels of contaminants in the raw water because levels of nitrogen or phosphate compounds, the main contaminants of concern, may occur naturally or downstream of municipal sewage outfalls at concentrations high enough to affect the industry's compliance with the guidelines. The coal mining waste water effluent guidelines, on the other hand, state that for total suspended solids the 24-hour average objective is 50 mg/L maximum absolute or 10 mg/L maximum above the natural background concentration (Alberta Environment 1978a). The natural background concentration is the receiving stream concentration upstream of the point of discharge or, if this water is

considered to be polluted by other activities, then reference will be made to an unaffected stream in the vicinity (Alberta Environment 1978a: 17).

As noted in the petroleum refineries effluent guidelines, "where Water Management data indicate the necessity for more stringent effluent requirements, permits and operating licences should be tailored to the needs of that particular watercourse" (Alberta Environment 1976a: 1). For example, industry may be required to have enough retention capacity to avoid maximum release of contaminants during low flow periods.

The modification to the Proctor and Gamble licence provides an example of altering licence terms to accommodate local conditions. As a result of considerable public concern about local water quality, more stringent licence conditions were incorporated into the renewed licence. A renewal of Proctor and Gamble's operating licence, issued in April of 1983, was rescinded on May 4, 1983 pending department review (*Hansard* 1983). The licence was renewed on October 13, 1983 and now contains requirements respecting color loadings (and resultant color in the Smoky River) as well as a requirement to reduce these loadings by January 1, 1988.

However, a review of several other industrial licences showed no such modification of conditions or tailoring of effluent quality to conditions of the receiving watercourse. Each facility was required to meet the published industry group guidelines. Several municipalities, however, have recently upgraded their treatment systems at the request of the Department.

Apparently an informal, in-house mechanism has been developed whereby improvements in technology may be incorporated even though new guidelines may not be published. The absence of published updated guidelines can be explained by two arguments. Initially, as is department policy, "standards" were stringent enough that they did not need to be revised frequently (Alberta Environment 1977b). The present industrial effluent guidelines were therefore developed to provide more than adequate environmental protection. It has not been necessary to produce more stringent guidelines because it is felt that existing water quality has not indicated the need for more stringent requirements.

The other argument is that as technology improved over the years these improvements have been incorporated in licence amendments or renewals. For example, more stringent BOD and suspended solids concentration values have been applied to those gas plants having an effluent discharge. Also, companies may expand their product output, but the licence limit remains the same, indicating that less pollution is produced per unit of output. This provides an incentive for the incorporation of improved technology during planned expansion or alteration. As well, many companies operate below their licensed limits. Therefore, although the public may be unaware of it, advances in pollution control have been incorporated into the design of new or expanded facilities.

It is clear from the guidelines, their stated objectives, and the process by which they were developed that the expected quality of the effluent is not related directly to receiving water quality, but is based on the capacity of industry to reduce the emission of contaminants, that is, best practicable technology. This is in keeping with the policy direction provided by the Role and Mission statement: to prevent or control pollution in order to protect the environment. Achieving the numerical objectives for surface water quality is a by-product of the process of regulating the release of environmental contaminants, although in an informal

sense, the Surface Water Quality Objectives do play a role. They may be used as a "big stick" to justify improvements in effluent control which may be required of industries or municipalities. As well, the capacity of the receiving water body to dilute wastes to levels that meet the objectives is considered when facilities such as retention ponds are designed, such that during low flow periods in the receiving waters there is still at least a 10 to 1 dilution of the industrial effluent.

However, pollution control activities would have more direction and influence if they were more firmly linked with achieving stated departmental goals and policies with respect to water quality instead of being restricted to the prevention of pollution. The present informal approach to the application of the surface water quality objectives, although it may provide a mechanism which is time efficient, flexible, and responsive to the local economic, social, and technological aspects of the situation, may lead to inconsistent achievement of surface water quality objectives. A clear understanding of the government's goals for water quality and its commitment to protection of Alberta's water quality is desirable. Each licensing decision should be made in the light of predicted impacts of that facility's effluents on achieving the province's goals for water quality and the possibility of applying advances in pollution control technology.

MUNICIPAL EFFLUENT GUIDELINES

The approach to the control of municipal effluents is quite different from that for industrial effluents. For municipalities, effluent releases are based on what might be achieved by a range of treatments commonly classified as secondary treatment. Depending on the exact processes used, the population served, the sewage flow rates, and other factors, the effluent quality achieved varies within a range. For example, an 85 to 95 percent reduction in BOD levels is expected in the treatment process. The resultant level of BOD in the effluent is expected to fall between 15 and 30 mg/L. According to Department staff, the level of technology required to meet the criteria for secondary treatment is generally considered to be best practicable technology.

The release of contaminants from municipal waste water treatment facilities is guided by Recommended Standards for Water Supply and Sewerage (Alberta Environment 1978b), as specified in the Clean Water (Municipal Plants) Regulations. Where these Recommended Standards use the term "shall," it is an offense for a municipality not to comply with the document. Where "shall" is not used, the document provides unenforceable guidelines and the incorporation of the Recommended Standards into a licence does not necessarily result in binding limits for effluent releases, unlike industrial waste water licences.

The Recommended Standards document also provides guidance on applying for a licence for a water supply system or waste water treatment system and design criteria for a sanitary sewer system. Sewerage effluent water quality guidelines are also identified. The Recommended Standards provide "a general indication of the Department's objectives with respect to sewage treatment and...a general guide in evaluating the degree of treatment achieved" (Alberta Environment 1978b: 35). The objectives help the Department of the Environment assess the acceptability of applications on the basis of the treatment proposed and the characteristics of the receiving stream, as well as the efficiency of operating plants. The technology used may vary from municipality to municipality. As well, the effectiveness of

treatment may vary depending on climate and fluctuations in loading. However, it is expected that the concentrations of contaminants in the effluent will fall within the ranges given by the objectives. The general objectives are that provincial water shall be free from substances that will settle to form objectionable sludge deposits; floating debris, oil, grease, scum, and other floating materials in amounts sufficient to be unsightly or deleterious; materials producing color, odor, or other conditions in such a degree as to create a nuisance; and substances in concentrations or combinations which are toxic or harmful to human, animal, plant, or aquatic life. The turbidity of the receiving water shall not be increased by more than 25 Jackson turbidity units (JTU) by any point source discharge.

The document also provides three tables illustrating the expected ranges of effluent quality expected from certain treatment processes. The criteria describing water quality for effluents from secondary treatment facilities including effluents from aerated lagoons, a system typical of larger Alberta municipalities, are reproduced in Table 1. These criteria are under revision (Lang 1985: pers. comm.).

If a municipality is accepting industrial waste into its sewage system, additional treatment facilities may be required to maintain desirable stream conditions. The criteria in the Recommended Standards "are based primarily on experience with municipal sewage treatment and, therefore, some values may have to be altered when applied to industrial waste treatment" (Alberta Environment 1978b: 35). The objectives also allow the operator to assess the efficiency of plant operations. The document points out "that water courses primarily containing effluent will not meet the surface water quality objective even with secondary treatment" (Alberta Environment 1978b: 36).

The approach to licensing municipal water works seems to allow more discretion as to the level and type of treatment which will be implemented by different municipalities and permits consideration of the economic impact of the pollution control requirements on small municipalities. Certainly, if desired, improvement could be made in the quality of municipal effluents. For example, enhanced treatment could be used to reduce nutrient levels, or carbon adsorption to reduce concentrations of metal ions. Indeed several municipalities have improved their treatment capabilities at the request of the Department, but requiring such improvements universally would have substantial economic implications and hence licence conditions are handled with discretion. To assist in the continued improvement of municipal effluent quality, the Department implemented a grant program for sewage treatment and drinking water supplies. This program is now administered by the Department of Utilities and Telecommunications.

In the category of licences for municipal plants, there is a clear example of a licence tailored to fit the needs of the receiving watercourse. The City of Calgary has been required to implement a phosphorus removal program to help control eutrophication in the Bow River. The City of Edmonton, because of the different hydrologic regime of the North Saskatchewan River, has no phosphorus removal requirements, although the new regional sewage treatment facility downstream of Edmonton will be equipped for phosphorus removal.

The recommended standards for municipal sewage treatment plants do not specify reporting, sampling, or monitoring requirements as is the case for industrial guidelines. It is necessary to incorporate such conditions as part of each licence to operate.

Table 1. Criteria for Secondary Treatment*

Parameter	% Removal	Effluent Value
1. Ammonia Nitrogen	–	10 – 20 mg/L
2. BOD (5-day at 20 degrees C)	85 – 95	15 – 30 mg/L
3. Coliform Bacteria	99.5 – 99.9	20,000 – 200,000 per 100 mL
4. MBAS (Methylene Blue Active Substances)	80 – 95	0.2 – 0.8 mg/L
5. Dissolved Oxygen	–	3.5 mg/L
6. Oil and Grease (Ether Solubles)**	–	15 – 25 mg/L
7. pH	–	5.5 – 10.5
8. Phenolics**	–	20 – 40 ppb
9. Suspended Solids	85 – 95	15 – 30 mg/L
10. Phosphorus as PO_4	–	15 – 30 mg/L
11. Temperature	– Not to be increased by more than 3 degrees C above ambient water temperature.	
12. Odor	– The cold (20 degrees C) threshold odor number not to exceed eight.	
13. Color	– Transmittance not to be decreased more than 30 percent below natural value.	
14. Turbidity	– Not to exceed more than 25 Jackson units over natural turbidity.	

* including aerated lagoons

**applied to any effluent regardless of treatment.

Source: Alberta Environment 1978b

It is interesting to note that municipal licences do not specifically incorporate the Recommended Standards for Water Supply and Sewerage (Alberta Environment 1978b) nor do the licenses of the major municipalities specify effluent limits for all of the parameters contained in the Recommended Standards. It is more common for the licence to specify limits, monitoring, and reporting only for biochemical oxygen demand (BOD) and non-filterable residues.

The rationale behind this approach is that experience has shown that if the facilities are designed and operated so that BOD concentrations in the effluents fall within the ranges specified in the objectives, then the treatment plant is operating efficiently and most other parameters will fall within the limits indicated in the criteria (Spink 1985: pers. comm.). Therefore, only BOD and non-filterable residues are monitored. This results in substantial savings in staff time and dollars.

The Recommended Standards specify no objectives for heavy metals or other chemicals, except oils and phenolics. A municipality accepts industrial effluents according to its own criteria, and is responsible for meeting the provincial requirements respecting the release of sewage. However, even licences for major cities which accept substantial volumes of industrial waste usually specify limits only for BOD and non-filterable residues and not for parameters such as metals. According to Milos, there are no guidelines for the concentration

of metals in sewage effluents because the present systems do not treat metals (Milos 1985: pers. comm.). To meet guidelines for metals would require state-of-the-art improvement in sewage treatment, which Alberta is not in a position to undertake because metals evaluation is such a massive task. In any case, the increase in concentration of metals is usually barely if at all detectable because of the large volumes of waste waters generated at cities such as Calgary and Edmonton and because existing sewage treatment systems, although not specifically designed to treat metals, are very effective at concentrating them in the sewage sludge.

To assist municipalities when negotiating with industries wishing to discharge waste water into a municipal sewer system, Alberta Environment has developed a publication entitled *Guidelines for the Control of Industrial Wastes Discharging to Municipal Sewerage Systems* (Alberta Environment 1978c). This document contains suggested limits for several metals and other substances that can be expected in industrial wastes entering the sewerage system of small to medium-sized municipalities (Appendix D). The limits, however, are only guidelines and it is up to each municipality to establish conditions with respect to industrial discharges, apply them to industrial operations, and develop a process for monitoring and enforcing those conditions. As the guidelines note: "municipalities are free to set their own limits depending on what their individual collection and treatment system can handle" (Alberta Environment 1978c: Foreword).

Since neither the provincial Recommended Standards for Water Supply and Sewerage nor a municipality's licence stipulate any limits on the release of "exotic" pollutants such as metals, there seems to be very little incentive for a municipality to refuse industrial effluents. Alberta Environment suggests that "there is basically only one effective way of controlling inputs to a municipal sewerage system, and that is by use of by-laws and user fees and an effective administration program" (Alberta Environment 1978c: 13), and the guidelines contain a model bylaw. Major Alberta cities do have sewer use bylaws, which are usually directed at applying a surcharge on industrial users for release of large volumes of biodegradable waste. The surcharge is based on flow, BOD, and suspended solid loading. The City is responsible for monitoring industrial discharges to municipal sewers and for enforcing the bylaw.

Nevertheless, some cities, including Edmonton, are updating their bylaws to take into consideration "exotic" contaminants, possibly to the extent of making it an offense to release contaminants which are not treatable in a typical secondary treatment plant. The impetus for tightening the bylaw is three-fold: concern over the impact of contaminants, particularly heavy metals, on the operation of biological treatment systems, especially anaerobic digesters; concern over impacts of discharges on the receiving water; and concern that the sewage sludge generated by the plant be within guidelines developed by Alberta Environment for land disposal of sewage sludge (McCoy et al. n.d., Alberta Environment n.d.b). Because land disposal of sludge instead of landfilling is now the preferred method of disposal, concentrations of heavy metals must be kept as low as possible in order to obtain permission from Alberta Environment to dispose of the sludge on land.

Municipal sewer systems are the recipients of a wide variety of "traditional" and "exotic" contaminants through the discharge of industrial and domestic wastes. However, the present approach to the control of contaminant releases in sewage plant effluent remains directed towards those "traditional" contaminants that impact water quality through a reduction in

oxygen levels and those which cause unsightly or odorous conditions. It has been left up to the municipalities to control the release of other contaminants. While there are control technologies that are practical and proven from an engineering standpoint, the difficulty remains in assessing what is economically practicable for municipalities. The decision to improve sewage treatment involves a weighing of costs and benefits influenced by the extent of public concern. Regardless, as an initial step, the major municipalities should be required to monitor the release of "exotic" contaminants in order to allow the Department of the Environment to develop a data base from which to determine future actions.

8. Permits and Licences

The Clean Water Act requires water facilities to have a permit to construct followed by a licence to operate. A water facility is defined in the Clean Water Act by a list of specific facilities as well as a plant, structure, or thing that may be a source of water contaminants. As mentioned previously, this requirement for permitting and licensing does not apply to industries discharging all of their wastes to a municipal plant, nor does it apply to non-point sources of waste discharge and some point sources, such as urban storm sewers.

The Director of Standards and Approvals may attach to a licence terms and conditions which, in his opinion, are necessary. The normal practice for industrial plants is to incorporate the appropriate industrial effluent guidelines as a condition of the license. Municipal plants are required to meet standards as specified by Regulations. In either case, other conditions may be added depending on the circumstances.

PERMIT TO CONSTRUCT

An operator of any plant which may be a source of water contaminants, except those exempted by the General Regulations, must apply for a permit to begin construction. The application must contain information about plant processes, materials used, amount of contaminants expected, and the pollution control proposed.

The application is reviewed by engineers within Standards and Approvals Division, and the Director may require any additional information deemed necessary. Based on knowledge of the industry, industrial processes, and pollution control technology as well as discussions with industry representatives, the Director determines the adequacy of the proposal to meet guidelines for that industry, or if no guidelines exist, determines if the operation would adequately control waste water discharge. The permit, if approved, is signed by the Director of Standards and Approvals, and construction may commence. The permit to construct may include conditions related to contaminants, concentrations, temperatures, amounts or rates of discharge of water contaminants, the manner and frequency of recording discharge, and the manner of testing before normal operation commences. If Alberta Environment staff become aware of a situation in which a person is constructing a facility without a permit, that person may be served a notice and directed to cease construction immediately. It is an offense to commence or continue construction without a permit, in contravention of a permit, or in contravention of a notice.

LICENCE TO OPERATE

Before a facility begins operation, the operator must obtain a licence. To acquire such a licence, the facility must be constructed in accordance with the permit and designed to operate in accordance with the licence. The application process is similar to that for a permit. The licence incorporates requirements with respect to emissions of waste water, usually the appropriate waste water effluent guidelines in whole or in part. For municipalities, the Recommended Standards referred to in the Regulations become conditions of the license. The licence usually contains requirements for effluent monitoring and reporting to government. These requirements may follow the industrial guidelines or be modified to suit the particular company's waste water stream and compliance record.

As an example, a licence for a petroleum refinery is discussed in detail (and is shown in Appendix G). The first portion of the licence defines terms and refers to the application for a description of the plant effluent, sewage, and storm water management practices. The next clause stipulates that releases of chemical oxygen demand, oil and grease, total suspended solids, phenols, sulphide, ammonia-nitrogen, threshold odor number, and pH shall conform with the Waste Water Effluent Guidelines for Alberta Petroleum Refineries (Alberta Environment 1976a). In addition, the maximum amounts of hexavalent chromium to be released are stipulated. Other conditions, relating to the effluent monitoring program and reporting schedules, correspond to Section 9.0 of the refinery waste water effluent guidelines with some modifications.

The licence requires weekly monitoring and monthly reporting for zinc and total phosphorus, although, in this particular case, limits on releases are not stipulated. This monitoring is for Alberta Environment's information. Collection of these data may indicate an emerging concern and flag an area where the company might expect future limits and controls to be required. Similarly, the operator is required to conduct quarterly fish bioassay tests. The results must be reported if the tests show acute toxicity. The action to be taken by the operator would be at the discretion of the Director of Pollution Control.

For facilities which do not fall under industrial waste water effluent guidelines, the licence is specific to the facility. The Director of the Standards and Approvals Division determines the effluent requirements and monitoring and reporting conditions that will be attached to the permit and licence. The process involves a thorough review of all processes which will be used, including quantification and characterization of all potential waste streams. The current technical literature is reviewed to determine available treatment technologies as well as the standards and approaches used in other jurisdictions. If similar operations exist, these are examined to determine the situation at those facilities. Finally, existing or potential environmental sensitivities in the area are identified. Operating conditions for the facility then are established through discussion between Department staff and the operator.

For example, a licence granted to a wood pole treating plant prohibits discharge of waste water to the surrounding watershed. Waste water is to be accumulated in an evaporation tank and evaporated and sludges are to be disposed of in a landfill approved by the Director of Standards and Approvals. Water quality in a slough and an on-site well are to be monitored. While parameters to be monitored are stipulated for the well water, they are not stipulated for water from the slough. The monitoring provides information to Alberta

Environment. The Department evaluates the information, assesses any potential hazards, and decides whether action is necessary. Action is taken at the Department's discretion.

Although there is no formalized mechanism for integrating air, land, and water aspects of waste management, information is co-ordinated through the organizational structure of the Standards and Approvals Division. In licensing facilities, the total waste management program of the facility is considered in order that, for example, air quality does not suffer at the expense of protecting water quality. Applications for permits and licences undergo concurrent review by experts in both water and air quality. The issuance of permits and licences is also approved by the Director of Standards and Approvals, who has responsibility for licensing under both the Clean Water Act and the Clean Air Act as well as responsibility for industrial waste management. As land disposal of industrial wastes becomes more restricted as a result of concern over the adequacy of landfills, the co-ordination and integration of all aspects of waste management will become increasingly important.

Conditions approved as terms of the licence become enforceable, since under the Clean Water Act it is an offense to operate a water facility without a licence or in contravention of a licence (s. 4(8)).

CERTIFICATE OF VARIANCE

Under the Clean Water Act, the holder of a permit or licence may apply to the Minister for a certificate of variance to vary a term or condition of a permit or licence. A certificate may be issued if the Minister is of the opinion that the water facility is operating in contravention to the permit or licence as a result of factors beyond the control of the applicant, and if the variation is not likely to result in water pollution that could be detrimental to life or health or adversely affect property, and if a refusal to grant a certificate would result in serious hardship to the applicant without an offsetting benefit to others. A certificate of variance is, therefore, issued at the discretion of the Minister after consideration of life, health, and property implications and the cost and benefits of the action. The terms "life," "health," and "property" are not defined in the Act, but according to Alberta Environment staff, are interpreted to include both human and non-human implications. To avoid any misunderstanding of the reasons for issuance of a certificate of variance, the press releases accompanying them are expected to explain clearly the basis for the certificate.

The Minister may impose special terms and conditions as part of the certificate. The certificate of variance is in effect for a specified time. Other conditions of the facility's permit or licence not varied by the certificate still apply.

The result of the issuance of a certificate of variance is approval for non-compliance only for that condition which is the subject of the variance. It does not negate further enforcement action. For example, a control order might be issued requiring steps to rectify the cause of the variation. Although certificates of variance have been issued under the Clean Air Act, none have been issued under the Clean Water Act. In the absence of specific regulations under Section 2(1)(e) and (f), which deals with emissions from a water facility, the approach of the Standards and Approvals Division is to make an adjustment to the conditions of the licence. The Division has facilitated the amendment application process for dealing with short-term variance that would not be detrimental to the water environment (Shewchuk 1985: pers. comm.).

9. Monitoring and Reporting

The Pollution Control Division is responsible for monitoring industrial and municipal effluents and enforcing the Clean Water Act as well as other environmental legislation. The Standards and Approvals Division licences industrial and municipal plants based on knowledge of the technology available and the effluent concentrations which can be expected to be achieved. Part of the licence is a requirement for the operator to monitor releases of certain contaminants. Depending on the parameter and the facility, monitoring may be done daily, several times per week, weekly, or monthly. Monitoring reports are filed with the Director of Pollution Control, monthly, quarterly, or annually, as specified in the licence or in guidelines for an industrial group.

Analysis of samples is required to follow procedures described in the most recent edition of *Standard Methods for the Examination of Waste and Wastewater* published by the American Public Health Association (APHA), American Water Works Association, and the Water Pollution Control Federation, or as described in *Methods Manual for Chemical Analysis of Water and Wastes, 1977* published by Alberta Environment. Other procedures must be approved in writing by the Director of Standards and Approvals and must produce results which can be confirmed using the APHA methodology. Apparently, as shown by evidence presented in Regina v. Suncor Inc., alternative sampling methods used by industry may not always have received this written approval. It seems essential that monitoring conform to the methods specified so that results provide an accurate and comparable record of the contaminant releases. Violation of this condition of a licence is an offense.

If water quality data are to be used in a prosecution, additional monitoring data may be required. These data would have to be collected in a manner which would ensure its acceptability as evidence in a court of law. This may include, for example, ensuring that the water samples could not have been tampered with. Collecting information which will stand up in court can be very costly and time-consuming.

The Director of Standards and Approvals may tighten licence requirements or add parameters to the monitoring requirements if monitoring shows a need to reduce effluent releases to a particular watercourse. Monitoring requirements may be relaxed upon written approval from the Director of Standards and Approvals if the quality of liquid effluent discharges is continuously in compliance with the licence. The requirements of the licence as to the manner and frequency of recording monitoring information also may be amended by the Director on application by the licence holder (s. 7(4)).

Monitoring information provided by industries and municipalities serves to notify the Pollution Control Division of levels of effluent discharges. It is the Division's decision as to what action will be taken. While "it is the policy of the Department that company data will not be used in prosecution against them" (Kupchanko 1982: 3), monitoring data, supplemented by the Department's own sampling, may form the basis for other enforcement actions such as Water Quality Control Orders or Pollution Control Directives. This is in fact the beginning of the enforcement sequence. Monitoring data also assist in making decisions with respect to licensing similar new facilities, and amendments to existing plants.

The Pollution Control Division also conducts spot checks and compliance surveys which serve to check the accuracy of a facility's monitoring information program, and help ensure that the facility is conforming with licensed requirements and that any modifications to the operation which may affect effluent quality have been reported to the Director of Standards and Approvals as required by the Clean Water Act. Alberta Environment's 1982-83 annual report indicates that all major licensed industries were inspected (Alberta Environment 1983b).

> *These inspections included assessment of the wastewater treatment facilities and assessment of waste water quality to determine compliance with licence requirements. Monthly and annual reports received from industry as a condition of licence requirements were also scrutinized for compliance* (Alberta Environment 1983b: 26).

Inspections by the Water Quality Control Branch are relatively infrequent, usually spot checks about once per month and more intensive compliance surveys once or twice per year for a particular company.

The Water Quality Control Branch of the Pollution Control Division previously published summaries of industrial monitoring data. For example, the Division published an annual industrial effluent monitoring report which summarized compliance for each licence, gave the annual volume of industrial effluent, and gave information on a licensee's performance including for comparison results of government sampling, and briefly commented on a company's pollution control activities (Alberta Environment 1982a). However, in mid-1983, the legality of releasing operator-submitted data was questioned by industry representatives and the Attorney General's Department recommended that data no longer be made available to the public. To clarify the situation, the Environment Statutes Amendment Act, 1983 was passed in late 1983. Section 2(1) of this Act amended the Clean Water Act to allow the Minister of the Environment to make an Order governing the manner and form in which industrial discharge monitoring information collected in compliance with the conditions of the licence is to be released to the public. The Release of Monitoring Information Order (AR 403/84) was subsequently filed on December 19, 1984. It is not yet clear exactly what impacts this regulation may have on the form and availability to the public of monitoring information submitted by the operator, and whether monitoring information gathered before the regulation was filed will be publicly available or only that submitted after the filing date. In addition, it is unclear whether "spill" reports submitted in compliance with the regulations will become publicly available or whether the Department intends to publish monitoring summaries or compliance reports. The availability of this information, including summary and compliance reports, published by the Department, would in the long term greatly assist the Department in making the public more aware of its efforts in pollution

control and in increasing public support for the Department's activities. Summaries of municipal effluent monitoring or compliance have not been published. Since municipal sources are often major contributors of contaminants to surface waters, the publishing of this information would increase public awareness of this aspect of pollution control.

Ambient water quality also is monitored by the Pollution Control Division. An automatic water quality sampling network has been established throughout the province with sampling sites predominately above and below the major urban municipalities. As well, Environment Canada monitors 11 sites in Alberta. At these sites, water samples are analyzed monthly for major cations and anions, organics, heavy metals, and pesticides. The analytical information is stored in a data system (NAQUADAT) managed by Environment Canada and is forwarded routinely to Alberta Environment. Alberta also contributes to the PPWB water quality program. Under this program, five sites near the Alberta-Saskatchewan border are sampled monthly.

The Pollution Control Division also carries out monitoring to obtain baseline data for the assessment of environmental quality and the effect on the environment of emissions from facilities. The collection of baseline data is supplemented with the collection of data for the resolution of specific pollution problems or complaints, most recently, for example, on the Wapiti, Bow, and North Saskatchewan Rivers. Fish populations are not monitored by Alberta Environment. Monitoring of these populations and the possible impacts of water discharges and surface water quality on them remain the responsibility of the Fish and Wildlife Division of Alberta Energy and Natural Resources.

10. Enforcement

The purpose of enforcement is "to achieve safe and publicly acceptable levels of environmental quality" (Alberta Environment 1983b: 25). Within the Pollution Control Division, enforcement is considered to mean "any activity that is undertaken by the Department to ensure a facility complies with the environmental legislation to ensure their emissions will have a minimal effect on our environment and not affect our overall use and enjoyment of our environment" (Alberta Environment 1984a: Enforcement-Compliance, page 1).

Enforcement in Alberta follows a hierarchy of increasing severity and environmental concern: co-operation, directives, control orders, prosecution, and stop orders.

The co-operative approach is used when "the emission problem is of limited environmental or health concern; the levels are just over, or close to, the licence requirements and guidelines; and the frequency of the occurrence is low" (Kupchanko 1982: 10). Pollution Control Division staff meet with staff from the industry or municipality to agree on ways to resolve the problem. Through subsequent correspondence, the action to be taken and date of completion are documented. A similar process is outlined in an Alberta Environment report that states:

> *If a contravention is reported, the events leading up to or surrounding this period are reviewed to determine the cause of the contravention, the action taken by the plant at the time of the event and the immediate and long-term preventative measures pursued by the company to avoid the problem recurring. In instances where the company has taken every reasonable action available to minimize the impact, no further action is taken by the Department* (Alberta Environment 1982b: 1-2).

If non-compliance persists, the Department will undertake more serious action.

The next step in the hierarchy of enforcement is a directive. A directive may be issued after a hearing, a private meeting held between the Director of Pollution Control, his staff, and the management of the facility.

> *Hearings are held when co-operation falters or is too slow; the emissions are such that they may start to be of environmental concern; emissions are in excess of limits (licence or guidelines) and occur frequently; or the emissions themselves are of concern to the Department* (Kupchanko 1982: 11).

These meetings resolve procedures to be followed to rectify the problem, and establish dates and reporting schedules. Directives have no legal authority under the Clean Water Act, but are used to formally request information on a specific concern, to confirm corrective actions agreed upon, and to request status reports on any of these. News releases notify the public of the information request.

Unlike directives, control orders are duly served, legal documents. It is an offense not to comply with a control order and there is no formal appeal process.

> *Control Orders are issued when emissions are likely to have an environmental effect; may commence to have some health significance; are extremely in excess of licence or guideline requirements; are frequently over licence or guideline levels; and where previous commitments to the Department have not been met* (Kupchanko 1982: 11).

This quotation illustrates that it is a discretionary decision (by the Director of Pollution Control) to choose the legal route instead of discussion and co-operation, and is a matter of Departmental policy rather than a strict interpretation of the legislation. Control orders may be issued without going through technical meetings and directives, but normally the facility's management is given the opportunity to control the source of pollution before a control order is issued. Although the quotation refers to "environmental effect," the Clean Water Act does not specify "environmental effects" as a condition for issuance of a control order; instead the Act states that a control order may be issued if the water has a disagreeable appearance, or is likely to be detrimental to life or health or adversely affect property. In keeping with the mandate of the Department, this has been interpreted to include environmental effects.

The Clean Water Act also permits the issuance of control orders whenever a water contaminant is being discharged in concentrations or amounts exceeding those prescribed by effluent discharge regulations or in contravention of a condition of the licence.

A control order also may be issued if concentrations of contaminants in surface water exceed those prescribed by regulations. This provision was intended to apply mainly to allowing the department to order treatment or upgraded treatment when raw water was inadequate to be used as a source of drinking water (Milos 1985: pers. comm.). However, no regulations have been issued prescribing allowable concentrations of contaminants in surface water.

Since no regulations have been issued for concentration of contaminants in effluents or in surface waters, it is at the discretion of the Director of Pollution Control to issue a control order for the other reasons specified in the Act. Control orders have been used sparingly. Thirty-three water quality control orders were issued between 1972 and June of 1984. Enforcement capabilities would be improved if regulations were used to establish acceptable concentrations and amounts for contaminants in effluent discharges. Limits at least as strict then could be incorporated into operating licenses. The establishment of limits through regulation would be particularly useful in the application of the "general prohibition" clause with respect to unlicensed discharges, where it would no longer be necessary to prove that each release was likely to render the receiving water harmful.

Even at the control order stage of enforcement, co-operation continues. A control order is usually written following a meeting between the Department and management staff from the water facility. The control order specifies corrective actions to be taken by the operator and the time period for compliance. The control order may also specify interim measures and require progress reports. A news release informs the public of the conditions of the control order. Control orders may be amended by the Director of Pollution Control; amendments, for example, may allow the company more time to obtain and install the required pollution control equipment.

Prosecution may be the next step. The Department recommends to the Attorney General that charges be laid if a control order is not complied with or if unauthorized releases are not reported. Both actions are offenses under the Act. In keeping with the co-operative approach of the Department, it is most important that releases be reported and control orders obeyed. It has become government policy that approval from the Attorney General is required before any charges are laid, although under the Clean Water Act such approval is required only in conjunction with the application of Section 17, the "general prohibition" provision.

A stop order, the strongest and most immediate enforcement method, is issued by the Minister. A stop order may be issued if a facility contravenes the Act, an order, a regulation, or a condition of its licence; fails to comply with an order or direction from the Director of Pollution Control; or is, in the opinion of the Minister, a source of water pollution which is considered to be an immediate danger to human life or property.

A facility may be required to cease the contravention and stop any operations either permanently or for a specified period. One stop order has been issued under the Clean Water Act. That was issued to Evergreen Mobile Park in 1976 for operating a water works system and sewerage project without approval. Alberta Environment has issued three other stop orders, one in 1973 under the Department of the Environment Act for non-compliance with a section of the Water Resources Act, and two for non-compliance with the Clean Air Act, one in 1979 and one in 1983.

There is clearly a difference in the severity of control orders and stop orders. The stop order is more sweeping in its authority and can be applied for contravention of any aspect of the Act and its regulations. The main difference between the two actions, according to the wording of the Act, appears to be the degree and immediacy of the threat to life or health or property. Control orders may be used when a water contaminant is or is likely to be detrimental to life or health or property. Stop orders may be used against a source of water pollution which is considered by the Minister to be an immediate danger to human life or property or both. Non-human environmental concerns are not stipulated as grounds for issuance of a control order, while the conditions for issuance of a stop order under the Clean Water Act specify "human life." However, according to Alberta Environment staff, environmental concerns are considered before any enforcement proceeds. In fact, a recent Pollution Control Division report indicates that a stop order may be issued when a person (facility) "in the opinion of the Minister, is causing or is likely to cause the destruction, damage or pollution of a natural resource (i.e., land, plant life, animal life, water and air, including human life and property)" (Alberta Environment 1984a: Environmental Management Program — Stop Order, page 1). This wording is used in the Department of the Environment

Act and is a broader mandate than in the Clean Water Act. If carried over into practice, it could result in a much greater use of stop orders than has occurred in the past. A clearer identification of the conditions under which a stop order may be issued under the Clean Water Act would help avoid confusion between the operational use of the terms and the sense implied by the wording of the Act. The need for clarification also applies to the term "water pollution" in the conditions for issuance of a stop order as compared with the term "water contaminant" for a control order.

It is clear from the Department's approach to enforcement that enforcement does not necessarily mean prosecution for violations; enforcement means achieving compliance with the licensed conditions. The preferred approach to achieving compliance is through co-operation and persuasion. Unfortunately, this philosophy is not adequately understood or accepted by the public and concerns frequently are voiced that neither the enforcement strategy nor level of compliance is adequate.

In Canada, a co-operative approach to obtaining compliance is not unusual. In all Canadian jurisdictions surveyed by Franson et al. (1982), it is the preferred method. The authors suggest that enforcement through co-operation may be the preferred approach because of several difficulties associated with a prosecution-oriented enforcement strategy. The main difficulty seems to be the defense of "due diligence," whereby polluters defend against prosecution by showing that they were reasonably diligent in trying to comply with the standards. In addition, it is often difficult to prove the facts beyond a reasonable doubt (as required in criminal prosecutions) when dealing with monitoring results. Another problem is that frequently fines imposed by the courts are so small that it does not seem worthwhile to prosecute. For these reasons, according to Franson et al., a co-operative enforcement strategy is often preferred.

Experience with prosecution in Alberta has been limited either for the reasons given above or because "more often than not, the problems are corrected promptly and no further action on the part of the government is required, as can be seen from the Department's prosecution rate of 6.21 charges average per year" (Alberta Environment 1984a: Prosecution Review, page 2). This statement was made with respect to the enforcement of all Acts and Regulations administered by the Department. Under the Clean Water Act and Regulations, 24 charges were laid in the period 1972–1984. Eight charges resulted in guilty pleas, one conviction was obtained, and 14 charges were dismissed or withdrawn. Some cases were withdrawn because of cessation of the operation or as a result of plea bargaining. Fines ranged from $200 to $1,500 and averaged $600. According to the Pollution Control Division, the vast majority of cases that went to prosecution were successful from an environmental point of view (Alberta Environment 1984a). Pollution control devices were installed where necessary, practices causing pollution ceased, and licences to operate were obtained.

> *The Division is of the opinion that the compliance record is more important than the number of successful prosecutions undertaken or the amount of money collected through hefty fines; prosecution is but another necessary and effective tool in [the Division's] Environmental Enforcement Program* (Alberta Environment 1984a: Prosecution Review, page 6).

While attempting to achieve compliance through co-operation and persuasion, the Department accepts that "compliance with the licence emission limit 100 percent of the time is not practical" (Briggs 1983: 12). This is because many factors — operating mode, installation of new equipment, maintenance procedures, and repairs — affect the efficiency of pollution control and the effluent levels. All contraventions are investigated and the action then taken by the Pollution Control Division depends on the cause, extent, and frequency of the excess; the health or environmental significance; past performance; and the corrective measures taken.

During the period from July 1983 to June 1984, 45,812 industrial effluent water quality monitoring tests were submitted to the Pollution Control Division; 45,308 complied with the licensed requirements. For various industrial sectors, the compliance rate ranged from 97 percent to 100 percent, with an average compliance rate of 98.9 percent (Alberta Environment 1984a).

These calculations reflect compliance with licensed limits on effluent releases as contained in company reports. However, most environmental problems are not identified through company-submitted effluent sampling data. The Environmental Enforcement Program report shows that most water quality control orders are issued as a result of public complaints or government review of environmental reports submitted by industry as required by the licence (Alberta Environment 1984a). These latter reports may cover a variety of things, for example: bioassay results, process chemicals used and their disposition, releases of contaminants for which there are no licensed limits, retention and monitoring of plant storm water runoff, or timing of release of ponded waste waters. The Environmental Enforcement Program report lists the 34 water quality control orders issued between 1972 and 1984: 11 were issued as a result of public complaints, 15 as a result of departmental review of reports submitted by industry as required by licence, five were based on Pollution Control Division sampling of effluents, and only three were based on company-submitted effluent monitoring data.

These data include control orders against municipal sources which are not included in the compliance data above, as well as those issued against unlicensed sources that do not provide monitoring data. A report documenting the compliance of municipalities with licensed limits for effluent releases would allow a useful comparison with the data on industrial compliance. Nevertheless, the data suggest that effluent monitoring information reported by industry does not often result in enforcement action. Government scrutiny of other environmental data or follow-up on public complaints are much more useful in detecting potential problems. Increasing public vigilance and knowledge with regard to spotting and reporting instances of environmental pollution seems to be a cost-effective way of achieving compliance. As well, the Department should assess its programs for plant inspection and review of environmental monitoring data in order to determine the most effective means of utilizing these programs to achieve compliance by industry and municipalities with the Clean Water Act and its regulations.

While it may be logical and, from a technological point of view, eminently practical to recognize that 100 percent compliance is not possible, neither the terms and conditions of a licence nor the wording of the Act and the regulations acknowledge this point. The public, therefore, sees any contravention as a violation which requires prosecution. Licence con-

ditions which identify the compliance expectations, or provide an expected level of emission as well as a limit on the extent of variance acceptable, would seem to provide a more appropriate base for enforcement. An example of this type of condition can be found in the Surface Water Quality Objectives. The objective for coliforms states that "at least 90 per cent of the samples (not less than five samples in any consecutive 30-day period) should have a total coliform density of less than 5,000 per 100 ml" (Alberta Environment 1977a: 5). An identification of a maximum permissible limit could be included. Stating licence conditions in this form would provide clear direction to enforcement staff concerning the acceptable variance in effluent quality and reduce the judgmental aspects of enforcement. In addition, the identification of acceptable variances implicitly recognizes some of the technical difficulties of maintaining a consistent effluent quality, and provides allowance for accidental excursions while identifying water quality levels which the public could expect to be attained 100 percent of the time. A contravention could then be treated as a violation requiring serious enforcement action.

Among the public, a majority feel that the enforcement of environmental regulations is not strict enough (MIR 1981) despite the apparent success of Alberta Environment in achieving compliance through co-operation with industry. In part, this perception relates to which point of view is emphasized. For example, is the focus on the 98.9 percent compliance rate obtained for industrial waste water effluent in 1983-84 (Alberta Environment 1984a) or on the fact that this rate represented 504 contraventions of licence requirements in a 12-month period? A favorite public analogy is to compare licence requirements with speed limits. The comparison suggests that the police (the Environment Department) observed these contraventions and did not prosecute these recorded violations of the regulations.

Wording conditions of a license to recognize that variances are inevitable and acceptable, within limits, would provide direction to departmental staff, clarify operating limits for industry, and assure the public that the environment is being protected. Identifying acceptable variances and a maximum permissible limit that accurately reflects the current objectives of environmental protection could help to close the gap between public perception and departmental achievement. However, having established acceptable levels of emissions and variances, any contravention detected would require vigorous enforcement with greater use of control orders than is presently the case.

11. Surface Water Quality

Although several reports on surface water quality have been published by Alberta Environment, most contain data summaries only. There is no comprehensive study of water quality in Alberta, with an assessment of the implication for future water quality management. While a recent study (Reynoldson 1983) compares water quality in the North Saskatchewan River for 1970-77 with water quality during 1977-81 and a report by Bouthillier (1984) provides a mainly qualitative historical perspective and discussion of water quality in the same river over the period from the 1950s to the 1980s, neither study looks at water quality trends and their implications. A report discussing water quality in the Bow River from 1970 to 1980 was prepared in 1982 and released in 1984 (Hamilton 1982). This report analyzes and discusses water quality in the river for the periods 1970 to 1975 and 1976 to 1980.

Other data summaries have been published. For example, the Department presented the fall-winter 1982/83 surface water quality data in a report published in 1983 (Alberta Environment 1983c). The intention apparently was to produce summaries quarterly, although no recent summaries have been released. Other reports dealing with water quality have been prepared for specific purposes (see Alberta Environment 1984b, Reynoldson and Livingstone 1983) and information has been analyzed and presented in reports associated with regional utilities studies (Reid, Crowther and Partners 1980, R.P.A. Consultants Limited 1978). In addition, the Prairie Provinces Water Board occasionally publishes water quality data collected at PPWB monitoring stations close to the Alberta-Saskatchewan border (PPWB 1983).

This report, therefore, undertakes to review some of the water quality data and existing literature in order to obtain a general overview of water quality in the province. The intent is not to conduct an exhaustive or all-encompassing analysis; that could only be done by Alberta Environment. The analysis relies principally on publicly available data obtained from the computer data bank managed by the federal government (NAQUADAT). This data bank contains monitoring data from approximately 1970 onward. Earlier data have not been computerized. Caution must be exercised in any analysis of water quality data because of changing sampling and measuring techniques, variations in stream flows, and inconsistencies in the time of sampling, all of which affect the comparability and statistical validity of the data. In spite of these constraints, it is possible to make several broad conclusions.

TRENDS IN CONCENTRATIONS OF WATER QUALITY INDICATORS

Data for several environmental quality indicators – dissolved nitrite and nitrate, dissolved orthophosphate, total organic carbon, total coliform, and dissolved oxygen – were used to

generate linear regression equations relating concentration to time. Data were analyzed for locations on the North Saskatchewan, Red Deer, Bow, Oldman, and South Saskatchewan Rivers.

Only one of 16 equations generated was statistically significant (Appendix E) and that equation showed an improvement in nitrite and nitrate levels in the North Saskatchewan River at the Saskatchewan-Alberta border during the period from 1966 to 1974. The other equations showed no consistency in the direction of slope. Some suggested an improvement, others a deterioration, while some suggested no change in water quality. The inability to demonstrate statistically significant trends over time may be a function of the data. NAQUADAT data were inconsistent in the number of samples per year and the timing of sampling. In addition, the time span for sampling usually encompassed only a few years and trends may have been masked by year-to-year variation in stream discharge, year-to-year variation in the amount of a contaminant put into the river, and chemical and biological interactions in the river. On the other hand, there may have been no statistically significant changes for water quality during the last 10 years. This in itself would be encouraging, considering the rate of municipal and industrial development in Alberta during that period. An analysis of trends in loading (concentration multiplied by stream discharge) for five of the locations also yielded non-significant equations, indicating that yearly variations in discharge alone account for little of the year-to-year variation in water quality parameters.

Reynoldson (1983) looked at a wider variety of parameters for the North Saskatchewan River. Using a single simple average of values for the periods 1970 to 1977 and 1977 to 1981, he concluded that "there is indication of improving water quality based on lower levels of the nutrient and microbiological indicators. Certainly, there is no evidence of any deterioration in water quality over the period based on these data" (Reynoldson 1983: 3). The substances which indicated improving water quality were: total organic carbon — "slightly lower in the latter part of the decade" (Reynoldson 1983: 13), phenolic concentrations — "some slight reduction" (Reynoldson 1983: 13); mercury — "may in fact have been higher...in the early part of the decade" (Reynoldson 1983: 19), total phosphorus — "values are considerably higher in the early part of the decade" (Reynoldson 1983: 24), and coliforms, although not specifically mentioned, were lower in the latter part of the decade. This assessment of data suggests that there has been some improvement in certain water quality parameters related mainly to improved sewage treatment at Edmonton and the reductions in the discharge of mercury. Whether these reductions are statistically significant cannot be determined using Reynoldson's approach of comparing single, average values.

Although it is mainly a qualitative comparison of water quality in the North Saskatchewan River in the 1950s, 1970s, and 1980s and a discussion of pollution control during that period, Bouthillier's report seems to support Reynoldson's findings. Based on the information presented, he concluded that the improvements in dissolved oxygen levels noted during the winter over the period 1956 to 1980 "illustrate to a great extent the progress which has been made in river quality improvement over the years" (Bouthillier 1984: 23). He states that the improvement in water quality has been due to two major factors: the installation of waste treatment facilities for all wastes flowing to the North Saskatchewan River and the construction of dams upstream which assured winter flows of four to five times the minimum that occurred in the past.

In his summary of data for the Bow River, Hamilton suggests that water quality has shown improvement for several parameters downstream of Calgary (Hamilton 1982). For example, although they exceeded the surface water quality objectives during the '70s, phenol concentrations were reduced in the latter half of the decade, probably as a result of the closure of the Imperial Oil Refinery at Calgary. However, the herbicide 2,4-D, although still found at very low levels, seems to be increasing with time. For other parameters, Hamilton found increasing concentrations as one moves downstream. For some substances (for example, total salt concentrations, iron, and manganese), much of this increase likely is due to natural influences such as erosion, but for others (aluminum, nitrogen, and phosphorus compounds; alpha BHC; and bacteriological indicators) the main sources are anthropogenic.

FREQUENCY OF CONTAMINANTS IN EXCESS OF SURFACE WATER QUALITY OBJECTIVES

For another view of the quality of Alberta's waters, water quality was compared to the provincial surface water quality objectives (Appendix B). Eight water quality parameters — nitrite and nitrate, phosphorus, phenolic material, total coliforms, dissolved oxygen, copper, zinc, and cadmium — were selected for three locations: the North Saskatchewan River at the Pakan Bridge (approximately 100 km downstream of Edmonton near Smoky Lake), the Bow River near its confluence with the Oldman River, and the Smoky River at Watino (approximately 160 km downstream of Proctor and Gamble's pulp mill) (see Appendix F).

During the period from 1977 to 1982, none of the samples taken at Pakan exceeded the water quality objectives for nitrite and nitrates, dissolved oxygen, copper, zinc, and cadmium. However, the level of total coliforms frequently exceeded the one-day maximum for water used for direct contact recreation or vegetable irrigation (2,400 per 100 mL.). The coliform levels exceeded 2,400 per 100 mL in 12 of 45 samples taken between 1977 and 1982.

Phosphorus levels exceeded the total phosphorus objectives once. However, the data obtained from the NAQUADAT file measured dissolved nitrite and nitrate and dissolved orthophosphate, and therefore measured only a portion of the total nitrogen or phosphorus for which concentrations are stipulated in the Alberta Surface Water Quality Objectives.

The levels of phenolic material also occasionally exceeded the surface water quality objectives. Comparison of the concentration of the phenolic material downstream of Edmonton with levels at Devon (approximately 45 km upstream) by means of a paired difference test showed no significant difference in concentrations at the two locations. Therefore, phenolic material in the river is likely due to natural causes and not solely due to contributions from Edmonton and environs.

Information from R.P.A. Consultants Limited supports these findings. The report concluded that, in the reach of the North Saskatchewan River from Edmonton to approximately Smoky Lake, "total nitrogen, total phosphorus, fecal coliform and total coliform levels do not meet Provincial Objectives" (R.P.A. Consultants Limited 1978: 59). "Water from this reach would not be suitable for public water supply without a relatively advanced level of water treatment" (R.P.A. 1978: 60). In addition, the report noted that "ammonia-nitrogen

levels are too high to provide the degree of ecosystem protection generally accepted as standard" (R.P.A. 1978: 60). In the 145 km reach of the river from Duvernay (almost 180 km below Edmonton) to the Saskatchewan border, water quality improves, but "levels of total nitrogen and phosphorus still do not meet Provincial objectives" (R.P.A. 1978: 60).

Analyses of water quality data from approximately 370 km downstream of Calgary showed that phosphorus, phenolic material, oxygen, copper, zinc, and cadmium did not exceed surface water quality objectives. Total coliforms exceeded the objective of 2,400 per 100 mL, the objective for direct contact recreation use or for vegetable crop irrigation water, once in 39 samples taken between 1977 and 1982. The total nitrogen objective was frequently exceeded by dissolved nitrite and nitrate alone. In the period from 1967 to 1982, total nitrogen objectives were exceeded in 29 of 117 samples. In the five years from 1977 to 1982, 20 samples out of 61 exceeded the objective. At no time for a comparable number of samples was the objective for nitrogen exceeded at Cochrane, suggesting that sewage effluent and runoff from the Calgary area is mainly responsible for the contamination recorded downstream in the Bow River.

The regional utilities study for Calgary states that

> *The Bow accepts waste discharges from industrial sources, storm outfalls and the two City of Calgary waste treatment plants. The resultant change in water quality is considerable and concentrations of phosphorus, nitrogen and bacteria rise significantly above Provincial Criteria as the water flows through Calgary* (Reid, Crowther and Partners Ltd. 1980: 19, Vol. IV).*

The results from downstream of Calgary and Edmonton are not directly comparable since the distances between the cities and the sampling locations are substantially different (370 km compared with 110 km). This may explain why samples from the North Saskatchewan River frequently exceeded the coliform objective but water at the mouth of the Bow River did not. Coliforms are unable to survive for an extended period in surface waters and the numbers would be greatly reduced during the long travel time to the confluence of the Bow and Oldman rivers.

Hamilton surveyed a broad range of water quality indicators for the Bow River during the period from 1970 to 1980. The following are highlights of his findings with respect to contravention of the Alberta Surface Water Quality Objectives.

> *Phenol concentrations in the lower Bow River have exceeded Alberta Surface Water Quality Objectives (A.S.W.O.) and the Canadian Drinking Water Guideline concentrations (C.D.W.G.) during the 1970s, however, reduced levels in the latter half of the decade are attributed to closure of the Imperial Oil Refinery at Calgary* (Hamilton 1982: Summary).

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*These findings are not comparable to the author's findings but complement them. The sampling location used in the Reid, Crowther study was closer to Calgary. In addition, although not stated, it is likely that total phosphorus concentrations were measured. For the author's survey, the concentrations obtained from the NAQUADAT file were for dissolved orthophosphate only.

> *Iron and manganese increase longitudinally along the river to levels in the lower reaches which exceed A.S.W.O. and C.D.W.G. concentrations. These high concentrations can primarily be ascribed to natural erosion and groundwater input* (Hamilton 1982: Summary).

"Nitrogen and phosphorus compounds in the Bow River increase downstream of Calgary to levels which exceed the A.S.W.O." (Hamilton 1982: Summary), although concentrations will be lowered by the implementation of advanced phosphorus removal at both Calgary sewage treatment plants. The Summary also states that "Bow River bacteriological indicator levels comply with all surface water objectives except in the reach below Calgary where very high total and fecal coliform counts are observed downstream of Calgary's sewage treatment plant outfalls." However, according to data presented in the report, the maximum total coliform count near the confluence of the Bow and the Oldman has exceeded 15,000/100 mL.

The analysis of data at Watino on the Smoky River showed that concentrations of water contaminants regularly exceeded the Surface Water Quality Objectives for nitrogen and phosphorus, and occasionally for phenolic materials, copper, and zinc. The natural levels of these substances upstream of Grande Prairie were not examined, so it cannot be stated definitely that industrial and urban effluents were the main sources of the contaminants. It is worth noting, however, that the contaminant levels rarely exceeded the Surface Water Quality Objectives between 1967 and 1974, the year when a pulp mill began operating near Grande Prairie. The comparison of pre-1974 results with post-1974 results for nitrogen and phosphorus may, however, be misleading because prior to 1974 only the dissolved fractions were measured rather than the total nitrogen and total phosphorus. This would give a lower measurement not strictly comparable with water quality objectives which refer to total nitrogen and total phosphorus.

The intent of this discussion is to provide an overview of the present state of Alberta's water quality rather than a definitive analysis. The review showed no statistically significant change in Alberta's water quality in the past 10 years, except for an improvement in nitrite and nitrate levels in the North Saskatchewan River. Change, whether improvement or deterioration, may have occurred but is not statistically significant. Other reviews have found slight improvements in levels of traditional contaminants in the North Saskatchewan River (Reynoldson 1983) or an indication of great improvement in the winter dissolved oxygen levels (Bouthillier 1984) and a lowering of phenol concentrations in the Bow River (Hamilton 1982). Although these findings result in a somewhat contradictory and confusing sketch of the status of water quality, it is heartening, in light of Alberta's rapid growth in population and industrial capacity during the same period, that water quality seems to have improved, especially as compared with the 1950s. This is a reflection of the emphasis by Alberta Environment on the licensing and control of emissions, and improvements in the control of municipal effluents, which are the major sources of the "traditional" contaminants. However, the results of this and other studies are disheartening in that they show that, in spite of these efforts, Alberta's Surface Water Quality Objectives for some parameters are frequently exceeded and that these excesses occur at a number of locations in the province, in particular in those reaches of river downstream of the major municipalities. Alberta therefore has a good record of pollution control, but must maintain the effort to ensure that it does not fall back when urban and industrial development picks up in the future.

This assessment of existing levels of water quality has been based on fragmentary reports and publicly available data. What is required is a comprehensive study of the status of water quality, written in a manner which clearly and concisely describes the present situation, trends, and areas of concern. A province-wide study of water quality would provide Alberta Environment and the public with an understanding of the state of Alberta's water which cannot be obtained through the piecemeal studies conducted to date. Alberta Environment, as the agency responsible for water quality and possessor of the requisite technical capability, should undertake this review.

To be effective, such a study should contain a complete analysis of water quality data to identify trends in water quality, highlighting areas of potential concern, separating background from anthropogenic sources, and determining major contaminant sources. The results of the study would indicate for the Department and the public the present problem areas and possible future water quality difficulties. Used in conjunction with the province's Surface Water Quality Objectives, it could aid in planning the priorities of pollution control directed towards industrial or municipal sources, specific areas, or specific water quality parameters. The analysis would also assist in the development of policies for locating industrial development and determining level of pollution control, provide information to the public on the status of water quality in Alberta, and assist Alberta Environment in determining future license conditions.

12. Overview

This report set out to assess the role of the Clean Water Act in the management of surface water quality in Alberta. To do this involved a determination of provincial goals for water quality, a look at the responsibility of the province in water quality management, and a detailed discussion of the Clean Water Act and how it is implemented by the agency responsible, Alberta Environment.

This investigation identified that while Alberta has numerical objectives describing the quality desired for provincial waters, little direction about the purpose of these objectives is provided to the administrators responsible for their implementation. Without such policy direction, it becomes difficult to assess the role of the Act in water quality management. In fact, however, the Clean Water Act has played an essential role in protecting water quality and undoubtedly water quality is better now than it would have been without the Act. The focus of the Act is licensing and regulating the release of contaminants. Through this function, control of the quality of surface waters has been improved.

However, without policy goals for the management of water quality, the role of the Clean Water Act remains one of reducing the release of contaminants to the environment by application of best practicable technology. The quality of surface waters may or may not be protected adequately. The result depends on factors such as the density and nature of municipal and industrial effluents, the level of treatment considered practical, and the political, social, environmental, and economic situation. Monitoring results have shown that downstream of the major municipalities the present water quality does not meet all of the surface water quality objectives. Is this a concern? What action should be taken to improve the situation? It can be pointed out that there have been improvements in pollution control and that pollution control planners are working towards achieving the objectives, but is this adequate?

There are two aspects to pollution control — the system and its implementation. Pollution control activities should be based on a strong, enforceable, legislative foundation which provides the legal mechanism to compel pollution control. But the success of pollution control will depend on the implementation of effective policies and programs which ensure that the intent of the legislation is fulfilled. If the legislative base is weak, it will not provide the incentive nor the support for a successful environmental protection program. However, a strong legislative base does not automatically lead to successful pollution control; the intent of the legislation must be enforced.

While several other Departments and Acts affect the management of water quality in Alberta, the Clean Water Act remains Alberta's most significant piece of water pollution control legislation. The provisions of the Act have influenced the Department of the Environment's organizational structure and the Department's approach to environmental protection. Although the Act contains provisions for regulation of surface and underground water quality as well as a general prohibition on the deposit of contaminants which may be harmful to the environment, no regulations on the release of contaminants nor allowable concentrations in surface or underground water have been promulgated and the general prohibition clause has rarely been used. Instead, the emphasis of the Department in using the Clean Water Act has been on licensing the release of contaminants. Under the Act any source of water contaminants may be licensed. The Act is a powerful tool and most of the activities of Environmental Protection Services are associated with the evaluation of waste water facility applications, review of technology and plant design, and monitoring of effluent discharges. As a result, the staff is oriented heavily towards the engineering aspects of pollution control and the technical and economic ability of industry or municipalities to reduce their emissions. This is a logical outcome of the policy direction provided by the Water Resources Management Principles and the Role and Mission statement. These policies indicate that a purpose of the Department is to prevent and control pollution in order to protect the environment and the quality of life. However, "environment" and "quality of life" are not defined. Lacking a clear definition and statement of goals and an indication of how to proceed towards these goals, the focus will remain on control of effluent releases to watercourses through the application of best practicable technology, rather than on the achievement of some goal of environmental quality. An alternative approach would be to expect that wastes would only be allowed to be deposited in watercourses if there is no environmental damage.

This alternative would require considerably more emphasis by the Department on research, documentation, and monitoring of contaminant levels and their biological consequences. This is not to suggest that aquatic ecosystems can not be protected through the licensing of effluents; licensing is an integral part of any protection scheme. However, if the emphasis is on the control of pollution, the ultimate results will be to increase pollution levels to the maximum that can be tolerated, rather than maintaining or achieving the best environmental quality possible within technical and economic limits.

The present system of surface water quality monitoring does not provide a clear insight into possible implications of water pollution for aquatic ecosystems and the fisheries resources. Consideration of environmental impacts is at the discretion of the Director of Pollution Control or the Minister. This discretionary aspect is pervasive in the legislation and regulations, for example, in the provisions for attaching conditions to a licence and for enforcing the Act. While discretionary action may provide the government with the scope and flexibility to readily adapt to local needs and changing environmental concerns, it may also make the process more subject to short-term changes that will trade off long-term harm to the environment for short-term gain.

What is required is some solid base, some explicit long-term goal that provides a continuing reminder, to everyone involved in the process, of why the work is being undertaken and where we are heading. It is for this reason that Ontario has established explicit goals for water quality "to ensure that surface waters of the province are of a quality which is satis-

factory for aquatic life and recreation." Admittedly Ontario is more industrialized and densely populated than Alberta and it has more serious environmental problems that require greater, more concerted action. However, all those points suggest that Alberta could achieve the same goals as Ontario more readily, since it is easier to prevent deterioration than to try to restore water quality. Ontario's water quality goal might be popularly described as "fishable, swimmable waters" and should be seriously considered as an appropriate goal for all Alberta surface waters.

The Clean Water Act in fact says little about protecting the aquatic environment. Water pollution is defined as a contaminant in excess of permissible concentrations prescribed by the regulations — with no regulations, there would be no water pollution. Environmental impacts are not part of the legal grounds for issuance of certificates of variance, control orders, and stop orders. Environmental considerations are specifically identified only with respect to the general prohibition clause (s. 17) in which reference is made to "fish, wildlife, livestock or plants" as well as human health or life.

Monitoring of aquatic contaminants needs to be expanded to deal with a broader range of potentially harmful substances. Regulation of releases has concentrated on the "traditional" pollutants, although a few "exotic" substances may also be specified. However, like all jurisdictions, Alberta is faced with increasingly complex industries, and the addition of more chemicals to the environment. The technological ability to detect or measure chemicals has increased by leaps and bounds in the last decade, but our ability to determine the significance and risk posed by them has not kept pace. Numerous questions regarding the control of such chemicals have arisen. Does our ability to detect substances mean that they are recent additions to the environment? What were the background concentrations? What is the significance of measured levels in the environment? What levels of contaminants are acceptable? How can the costs and benefits of pollution control be balanced when so much is uncertain? These questions face today's regulators. Alberta Environment should meet this challenge and expand its approach to deal with the potential problems posed by "exotic" contaminants, beginning first with monitoring to identify their presence and concentration in Alberta surface waters.

There are a number of difficulties with the application of the Clean Water Act and its regulations. But the heart of the problem is that few of the provisions are easily and directly enforceable. For example, application of the general prohibition clause would require extensive monitoring by the Department in order to detect and prove the offense. The Act is directed towards licensed facilities and there it is fully effective. Licensed facilities may be prosecuted for failing to report a spill or violating terms of their licences. It does not seem necessary to prove harm or environmental damage in these instances, although sufficient monitoring must be done to detect and prove the offense.

The difficulty of enforcement of the Act is heightened by the absence of government regulations prescribing water contaminants and maximum permissible concentrations in surface waters or in effluent discharges. Regulations establishing limits on effluent discharges would enhance the use of the Act for the control of those sources of contaminants which are not normally licensed. Without such regulations, the only effective control of effluent releases is through the licensing process. Hence, the control order becomes an extremely important step in the enforcement process, since control orders from the Director

of Pollution Control Enforcement are legal documents which must be adhered to. However, the decision to issue a control order for excursions over licensed limits is discretionary. Some level of discretion is probably essential due to the complexity of environmental control. However, absolute discretion brings with it problems of vague guidelines for departmental staff, uncertainty for the industrial discharger, and suspicion from the public. To overcome these problems, the possibility of identifying permissible variances should be considered. The variances would have the function of a caution light in traffic control, to indicate that a problem exists and that corrective action should be taken. If variances within the acceptable limits occurred, this would be the level at which co-operation and Departmental directives could be used, since no legal offense has actually occurred. The variances should be accompanied by maximum permissible levels which would be the points at which legal action (control orders, prosecution, and stop orders) would begin, with the level to be used to be governed by the severity of the offense.

This approach is little different from that which occurs operationally at present. The difference is that rather than being at the absolute discretion of the Director of Pollution Control and the Minister, enforcement would take place within clear, explicit, and publicly identified boundaries. Such an approach would be a major contributor to increasing credibility and enhancing public confidence in Alberta Environment.

The Province has adopted the policy of enforcement through co-operation. Co-operation is an excellent goal in industry-government relations; however, co-operation occurs only if the objectives of the parties are identical, otherwise it deteriorates to become compromise. Undoubtedly the environmental attitudes of industries and municipalities have changed greatly over the last two decades, but the objectives of industry and Alberta Environment are not necessarily the same. If they were, there would be no need for a Department of the Environment; we could rely on industry to achieve the desired end without the problems encountered in dealing with a bureaucracy.

Industry "co-operates" because the alternative is compulsion. It makes sense for industry to work out the best possible compromise, through industry-government development of guidelines, through negotiation of licence conditions, and through negotiation of the terms of directives and control orders. From the government's point of view, this approach may be necessary if a limited staff is expected to develop guidelines and licences for all industries and keep abreast of process changes and technological advances in pollution control. It also fits well with the Department's role of balancing resource management, environmental protection, and the quality of life. However, if both guidelines and licence conditions have been negotiated with industry, why would government tolerate the shortcomings of a company that fails to live up to the mutually agreed-upon conditions? It may be that a different style of licence condition is needed, which would incorporate directly consideration of the level of compliance expected. This could include the concept of variance discussed previously. The use of contracts as suggested by Barton et al. (1984) could provide a suitable vehicle to incorporate such an approach. A contract could identify the conditions under which co-operation and directives would be used and those where control orders and prosecution would be invoked.

Alberta Environment seems to have difficulty coming to grips with the application of co-operation in its dual role as a standard-setting agency and an enforcer of the regulations.

While a spirit of co-operation may be very appropriate when developing standards and guidelines, it is not necessarily appropriate to the enforcement of the Act and its regulations once standards and conditions have been developed. These two aspects require different approaches — administrative versus legal. This dicotomy could be overcome, if, in the administrative process of developing standards, guidelines, licences, permits, or contracts, the point at which legal penalties would be invoked were clearly specified.

To provide clear policy direction, which would be essential in developing this alternative approach to the control of water pollution, an approach similar to Ontario's would have to be adopted. In that province the goal for water quality is clearly specified as "to ensure that the surface waters of the province are of a quality which is satisfactory for aquatic life and recreation" (Ontario Environment 1984: 4). A statement such as that identifies clearly the underlying purpose of the Department, the permits and licences, and the discussion with industry.

In addition, Ontario has adopted objectives for water quality which develop the goals more precisely; for aquatic life, objectives "are set at such values as to protect all forms of aquatic life and all aspects of the aquatic life cycles. The clear intention is to protect all life stages during indefinite exposure to the water" (Ontario Environment 1984: 10). Further, "the objectives for protection of recreational water uses are based on public health and aesthetic considerations" (Ontario Environment 1984: 10).

Following the statement of goals and objectives are policy statements which indicate in greater detail how the goals and objectives are to be achieved. For example, where water quality is better than the objectives "water quality shall be maintained at or above the Objectives" (Ontario Environment 1984: 4) and in areas where water quality does not meet the objectives, water quality "shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives" (Ontario Environment 1984: 5).

If the administration of the Clean Water Act were to be altered to provide for variances, adoption of a clear statement of goals and objectives and the policy to achieve them would be essential for the guidance of departmental staff, industry, and the public. Indeed, even if the current approach is retained, such a statement would be helpful in clarifying what is required from departmental staff, industry, and the public.

Any pollution control system, in order to be successful, requires both a strong legislative base and a commitment to the program's objectives. The Clean Water Act provides that legislative base, although it could be improved. But principally the Province needs to examine the existing surface water quality goals and objectives. The Department of the Environment could begin the development of new policy through a thorough review of the present state of Alberta's water quality and public discussion of provincial policy for water quality management. The Ontario statement of goals, objectives, and the policy for achieving them is a suitable model for Alberta water quality management, but we may wish to modify and alter it to recognize our particular conditions and situation. The development and adoption of clear goals, objectives, and policy would provide direction and support for the water quality managers, and stable goals for municipal government and industrial developers. The public should be involved in the development of these objectives. Their input, added to the technical and scientific base, will enable the decision makers to make

value judgements about the province's water quality goals and identify what is an acceptable "quality of life."

A change in philosophy to tie effluent releases to strong, well-supported (scientifically and socially) surface water quality objectives would give a meaningful direction to all activities in water quality management. The Clean Water Act and its system of licensing releases has the potential to achieve these objectives and continue to have an effective role in water quality management.

Appendix A. Statutes and Regulations

STATUTES

Federal

The Canada Water Act RSC 1970 c. 5 (1st Suppl.)
The Fisheries Act RSC 1970 c. F-14 (as amended to May 4, 1981)

Alberta

The Clean Air Act RSA 1980 c. C-12
The Clean Water Act RSA 1980 c. C-13 (as amended to June 1, 1982)
The Department of the Environment Act RSA 1980 c. D-19
The Energy Resources Conservation Act RSA 1980 c. E-11 (as amended to December 1, 1982)
The Environment Council Act RSA 1980 c. E-13
The Hazardous Chemicals Act RSA 1980 c. H-3
The Oil and Gas Conservation Act RSA 1980 c. O-5
The Plumbing and Drainage Act RSA 1980 c. P-10
The Public Health Act RSA 1980 c. P-27

REGULATIONS AND GUIDELINES UNDER THE FISHERIES ACT (CANADA)

Chlor-Alkali Mercury Liquid Effluent Regulations (SOR/77-575)
Meat and Poultry Products Plant Liquid Effluent Regulations (SOR/77-279) and Guidelines
Metal Mining Liquid Effluent Regulations (SOR/77-178) and Guidelines
Petroleum Refinery Liquid Effluent Regulations (SOR/73-670) and Guidelines
Potato Processing Plant Liquid Effluent Regulations (SOR/77-518) and Guidelines
Pulp and Paper Effluent Regulations (SOR/71-578) and Guidelines
Fish Processing Operations Liquid Effluent Guidelines. Environment Canada, Environmental Protection Service. EPS 1-WP-75-1. 6 pages.

ALBERTA REGULATIONS RELATING TO WATER QUALITY

Clean Water (General) Regulations (AR 35/73 with amendments up to and including AR 408/84)
Clean Water (Industrial Plants) Regulations (AR 36/73)
Clean Water (Municipal Plants) Regulations (AR 37/73 with amendments up to and including AR 83/82)
Oil and Gas Conservation Regulations (AR 151/71 with amendments up to and including AR 337/82)
Plumbing and Drainage Regulations (AR 340/77 with amendments up to and including AR 107/82)
Provincial Board of Health Regulations Respecting Water Supplies (AR 346/71 with amendments up to and including AR 284/78)
Stop Order Appeal Regulations (AR 9/74)
Release of Monitoring Information Order (AR 403/84)

Appendix B. Alberta Surface Water Quality Objectives

1) **Bacteriology (Coliform Group)**

   a) In waters to be withdrawn for treatment and distribution as a potable supply or used for outdoor recreation other than direct contact, at least 90 percent of the samples (not less than five samples in any consecutive 30-day period) should have a total coliform density of less than 5,000 per 100 mL and a fecal coliform density of less than 1,000 per 100 mL.

   b) In water used for direct contact recreation or vegetable crop irrigation the geometric mean of not less than five samples taken over not more than a 30-day period should not exceed 1,000 per 100 mL total coliforms, nor exceed these numbers in more than 20 percent of the samples examined during any month, nor exceed 2,400 per 100 mL total coliforms on any day.

2) **Dissolved Oxygen**

   A minimum of five mg/L at any time.

3) **Biochemical Oxygen Demand**

   Dependent on the assimilative capacity of the receiving water, the BOD must not exceed a limit which would create a dissolved oxygen content of less than five mg/L.

4) **Suspended Solids**

   Not to be increased by more than 10 mg/L over background value.

5) **pH**

   To be in the range of 6.5 to 8.5 pH units but not altered by more than 0.5 pH units from background value.

6) **Temperature**

   Not to be increased by more than $3^{o}C$ above ambient water temperature.

7) **Odor**

   The cold ($20^{o}C$) threshold odor number not to exceed eight.

8) **Color**

   Not to be increased more than 30 color units above natural value.

9) **Turbidity**

   Not to exceed more than 25 Jackson units over natural turbidity.

Source: Alberta Environment 1977a

Appendix C. Industrial and Municipal Waste Water Effluent Guidelines

INDUSTRIAL

Alberta Environment. 1973. *Gas Processing Plants, Waste Water Management Standards.* Standards and Approvals Division, Alberta Department of the Environment. 48 pages.

Alberta Environment. 1976a. *Waste Water Effluent Guidelines for Alberta Petroleum Refineries.* Standards and Approvals Division, Alberta Department of the Environment. 24 pages.

Alberta Environment. 1976b. *Waste Water Effluent Guidelines for Alberta Fertilizer Plants.* Standards and Approvals Division, Alberta Department of the Environment. 49 pages.

Alberta Environment. 1978a. *Alberta Coal Mining Waste Water Effluent Guidelines.* Standards and Approvals Division, Alberta Department of the Environment. 24 pages.

Alberta Environment. 1978b. *Guidelines for Alberta Brine Storage Reservoirs.* Standards and Approvals Division and Earth Sciences and Licencing Division, Alberta Department of the Environment. 16 pages.

Alberta Environment. 1980. *Waste Water Management Guidelines for Alberta Sand and Gravel Washing Operations.* Standards and Approvals Division, Alberta Department of the Environment. 12 pages.

MUNICIPAL

Alberta Environment. 1978. *Recommended Standards for Water Supply and Sewerage.* Standards and Approvals Division, Alberta Department of the Environment. 49 pages.

Appendix D. Limits on Waste Water to be Discharged to Municipal Systems

The following limits are intended to be a guideline for small to medium-sized municipalities. They indicate what a municipality may be able to safely accept into their treatment plant. If a municipality believes that they can absorb a stronger waste because of the size and capacity of their system, then they are free to do so; however, in the end, they must be able to meet Provincial final effluent requirements.

General goals for a waste water discharge to a sewerage system are that the waste water must be essentially free of:

1) material which is floatable;
2) solids that will settle out and deter the flow in pipe;
3) toxic substances;
4) excessive discoloration which is undesirable and unaesthetic; and
5) noxious odors.

A more detailed description of limits follows.

BASIC LIMITS FOR INDUSTRIAL EFFLUENTS DISCHARGING TO MUNICIPAL SEWERS

A) Prohibited Materials

No person shall release, discharge, suffer or allow the following sewage or waste to enter into the sewerage system:

1) any flammable or explosive materials;
2) a solvent or petroleum derivative including but not limited to gasoline, benzene, naptha, or fuel oil;
3) water containing wastes from oil or petroleum;
4) any chlorinated hydrocarbons;
5) carbon bisulphide, hydrogen sulphide, ammonia, trichloroethylene, sulphur dioxide, or formaldehyde;
6) any pesticides or herbicides;
7) any corrosive, noxious or malodorous material or substance which, either by itself or by reaction with other wastes, is capable of:
   a) causing damage to the sewerage system, or
   b) creating a public nuisance or hazard, or
   c) preventing any person from entering the sewers for purposes of maintenance or repair;
8) waste which, either by itself or upon the reaction with other material, becomes highly colored;

9) sewage having a pH rating less than 6.0 or greater than 9.0;
10) any waste animal parts or remains from meat processing or rendering or hide processing operations;
11) any ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, tar, plastic or wood;
12) sewage containing a radioactive substance;
13) sewage having a temperature in excess of 65.5^{o}C;
14) grit removed from commercial or industrial premises including but not limited to grit removed from car washing establishments, automobile garages and restaurant sumps or from interceptors;
15) any corrosive or toxic sewage or other wastes which could adversely affect the sewerage system;
16) sewage which will create tastes or odors in drinking water supplies making such waters unpalatable after conventional water purification treatment.

Source: Alberta Environment 1978c

Appendix E. Water Quality Trend Analysis

Linear regression equations describing trends over time of the concentrations of some water quality parameters at selected sampling locations in Alberta.

Water Quality Parameter	Location and Dates of Samples	Regression Equation	Correlation Coefficient Needed for the Equation to be of Statistical Significance
Dissolved Nitrate and Nitrite	North Saskatchewan River Pakan 1977-1982	1. y = .2013 + .0169x r = .5832 Not significant	$r_{4,.05}^{*} = .811$
	Lea Park 1966-1974	2. y = 1.4641 – .1706x r = – .9002 Significant	$r_{7,.01} = .798$
	Highway 3 in Saskatchewan 1971-1982	3. y = .6193 – .0365x r = .4170 Not significant	$r_{10,.05} = .576$
	Red Deer River Drumheller 1966-1982	4. y = .2314 + .0027x r = .1405 Not significant	$r_{15,.05} = .482$
	Bindloss 1967-1982	5. y = .3603 – .0104x r = .3788 Not significant	$r_{14,.05} = .497$
	Bow River near the mouth 1967-1982	6. y = .5107 + .0115x r = .2743 Not significant	$r_{14,.05} = .497$

$^{*}r_{4,.05}$ = correlation coefficient – 4 degrees of freedom, 5 percent level of statistical significance

APPENDIX E. Water Quality Trend Analysis (continued)

Water Quality Parameter	Location and Dates of Samples	Regression Equation	Correlation Coefficient Needed for the Equation to be of Statistical Significance
Dissolved Nitrate and Nitrite	Oldman River Highway 36 1967-1982	7. $y = .1477 - .0000x$ $r = .0003$ Not significant	$r_{14, .05} = .497$
	South Saskatchewan River Highway 41 1968, 1970-1982	8. $y = .4493 + .0013x$ $r = .0251$ Not significant	$r_{12, .05} = .532$
	Milk River near east crossing 1966-1982	9. $y = .3017 - .0092$ $r = -.3861$ Not significant	$r_{15, .05} = .482$
Orthophosphate	Bow River near the mouth 1970-1974, 1977-1979	10. $y = .0685 - .0018x$ $r = .2313$ Not significant	$r_{6, .05} = .707$
Total organic carbon	South Saskatchewan River Highway 41 1970-1978	11. $y = 5.6093 + .0168x$ $r = .0156$ Not significant	$r_{7, .05} = .666$

APPENDIX E. Water Quality Trend Analysis (continued)

Water Quality Parameter	Location and Dates of Samples	Regression Equation	Correlation Coefficient Needed for the Equation to be of Statistical Significance
Total coliforms	North Saskatchewan River Pakan 1977-1982	12. $y = 2545.5581 - 238.7166x$ $r = -.5450$ Not significant	$r_{4,.05} = .811$
		13. $y = 2927.5209\ (10)^{-.0931x}$ $r = -.6210$ Not significant	$r_{4,.05} = .811$
	Red Deer River Bindloss 1974-1982	14. $y = 392.622 - 50.6083x$ $r = -.5485$ Not significant	$r_{7,.05} = .666$
		15. $y = 187.0357\ (10)^{-.0606x}$ $r = -.3230$ Not significant	$r_{7,.05} = .666$
	Bow River near the mouth 1977-1982	16. $y = 679.9952 - 145.8494x$ $r = -.4188$ Not significant	$r_{4,.05} = .811$
		17. $y = 278.5428\ (10)^{-.2751x}$ $r = -.5764$ Not significant	$r_{4,.05} = .811$

APPENDIX E. Water Quality Trend Analysis (continued)

Water Quality Parameter	Location and Dates of Samples	Regression Equation	Correlation Coefficient Needed for the Equation to be of Statistical Significance
Dissolved oxygen	Red Deer River Drumheller 1974-1982	18. $y = 8.9493 - .1457x$ $r = .2334$ Not significant	$r_{7, .05} = .666$
	Bow River near the mouth 1974-1982	19. $y = 10.7600 + .0375x$ $r = .0989$ Not significant	$r_{7, .05} = .666$
	South Saskatchewan River Highway 41 1974-1982	20. $y = 11.2410 - .1589x$ $r = -.6360$ Not significant	$r_{7, .05} = .666$

Appendix F. Frequency of Exceeding Surface Water Quality Objectives

Table F-1. Frequency of exceeding Alberta's water quality objectives for some water quality parameters at Pakan

Year	Phosphorus		Phenolic Material		Total Coliform	
	Number of Samples	Number of Samples Greater Than Objective	Number of Samples	Number of Samples Greater Than Objective	Number of Samples	Number of Samples Greater Than Objective**
1977	2	0	2	0	2	1
1978	11	0	11	0	8	3
1979	6	0	12	2	11	2
1980	–	–	12	1	10	4
1981	–	–	11	0	8	2
1982	1*	1	6	0	6	0

* Total phosphorus measured rather than dissolved orthophosphate of the samples from 1977-1979

** The objective used is 2400/mL, which is the objective for direct contact recreation or vegetable crop irrigation

Table F-2. Frequency of exceeding Alberta's water quality objectives for some water quality parameters of the Bow River near the mouth

Year	Nitrogen (Nitrate and Nitrite)		Total Coliforms	
	Number of Samples	Number of Samples Greater Than Objective	Number of Samples	Number of Samples Greater Than Objective
1967	5	2	–	–
1968	9	0	–	–
1969	2	1	–	–
1970	10	0	–	–
1971	7	2	–	–
1972	9	2	–	–
1973	4	0	–	–
1974	4	0	–	–
1975	3	1	–	–
1976	3	1	–	–
1977	6	3	2	0
1978	12	4	11	1
1979	12	2	12	0
1980	12	4	5	0
1981	12	4	5	0
1982	7	3	4	0

Table F-3. Frequency of exceeding Alberta's water quality objectives for some water quality parameters at Watino

	Nitrogen		Phosphorus		Phenolic Material		Copper		Zinc	
Year	Number of Samples	Number of Samples Greater Than Objective	Number of Samples	Number of Samples Greater Than Objective	Number of Samples	Number of Samples Greater Than Objective	Number of Samples	Number of Samples Greater Than Objective	Number of Samples	Number of Samples Greater Than Objective
1967	13	0	6	0	–	–	2	0	2	0
1968	9	0	3	0	–	–	2	0	2	0
1969	11	0	3	0	–	–	–	–	–	–
1970	10	0	5	0	–	–	1	0	1	0
1971	7	0	2	0	–	–	2	0	2	0
1972	5	1	2	0	–	–	2	0	2	0
1973	7	0	4	0	–	–	2	0	2	0
1974	4	0	4	1	3	1	4	0	4	0
1975	3	0	3	1	3	3	3	0	3	0
1976	3	1	3	1	3	3	3	1	3	1
1977	6	1	6	1	6	1	4	0	4	1
1978	12	1	12	4	12	0	4	0	4	0
1979	12	2	12	3	5	1	4	1	4	1
1980	12	1	12	2	12	0	4	0	4	0
1981	12	2	12	2	10	0	4	0	3	0
1982	12	2	12	3	11	0	4	2	4	2

Appendix G. Sample Licence for a Petroleum Refinery

ALBERTA ENVIRONMENT

LICENCE TO OPERATE OR USE

Licence No. _____

Permit No. _____

File No. _____

TO _____

Pursuant to section 4 of the Clean Water Act, Revised Statutes of Alberta 1980 a licence to operate or use

is hereby issued subject to the terms, conditions and requirements attached hereto.

Edmonton _____

Director of Standards and Approvals

TERMS, CONDITIONS AND REQUIREMENTS ATTACHED TO LICENCE

1. In this licence, all terminology shall have the same meaning as in the Guidelines unless specified otherwise, and, in addition:

   (a) "application" means the application for a Licence to Operate the refinery submitted to the Standards and Approvals Division of Alberta Environment by the licensee dated....

   (b) "Guidelines" means the "Waste Water Effluent Guidelines for Alberta Petroleum Refineries -- dated August 16, 1976, and issued by Alberta Environment in accordance with Part 1, Section 6, of the Clean Water (General) Regulations being Alberta Statute 216/73;

   (c) "licensee" means...;

   (d) "reference crude rate" means ... thousand barrels (...cubic meters) of crude oil per day, as declared by the licensee in compliance with the Guidelines; and

   (e) "refinery" means the licensee's refinery, as described in application, located....

2. The refinery liquid effluent, sanitary sewage and storm water management shall be as described in the application.

3. The mass of chemical oxygen demand, oil and grease, total suspended solids, phenols, sulphide and ammonia-nitrogen released in the liquid effluent from the refinery to the...River shall not exceed the limitations specified in Columns 2, 3 and 4 of Table 1(a) of the Guidelines multiplied by the reference crude rate, except where higher limitations are authorized pursuant to clause 6.

4. The Threshold Odor Number and pH of the liquid effluent released from the refinery to the...River shall not exceed the limitations specified in Columns 2, 3 and 4 of Table 1(a) of the Guidelines.

5. The mass of hexavalent chromium released in the liquid effluent from the refinery to the...River shall not exceed 4.6 kilograms per day on any day.

6. In the event that storm water is included in the liquid effluent released from the refinery to the...River, the limitations specified in clause 3 may be increased in compliance with Table A of the Guidelines.

7. The quality of the storm water released from the tank farm retention pond shall conform to the standards specified in the "Discharge Rate" column of Table A of the Guidelines.

8. The licensee shall conduct a liquid effluent monitoring program in compliance with Section 9.0 of the Guidelines with the following exceptions:

   (a) hexavalent chromium shall be included in the 3 per week monitoring,

   (b) zinc and total phosphorus shall be included in the weekly monitoring,

   (c) the bioassay test may be performed quarterly in accordance with the guideline document "Waste Water Effluent Guidelines for 96-Hour Multiple Concentration Static Bioassay using Rainbow Trout", published by Alberta Environment, September 1978, and

   (d) the storm water released from the tank farm retention pond shall be analyzed weekly for those water contaminants specified in Table A of the Guidelines except during the freeze-up period.

9. The licensee shall comply with the reporting requirements specified in Section 8.0 of the Guidelines and shall include the additional monitoring data specified in clause 8.

EXPIRY DATE OF THIS LICENCE:

_____

Director

Review Engineer:

Section Review:

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